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Effect of Mobility Models on The Throughput Performance of Manet Routing Protocols

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ABSTRACT

Since nodes in a mobile ad hoc network (MANET) are constantly moving from one location to another, the network's topology is always changing. Because of this, picking a routing protocol that works well in different mobility scenarios is a major obstacle. This research documents the results of a performance evaluation of Dynamic Source Routing (DSR) and Destination Sequenced Distance Vector (DSDV), two popular MANET routing protocols, using simulations under various mobility scenarios. The protocols are tested using NS-2 (version 2.27), and their UDP throughput is examined in relation to four different mobility models: Freeway, Manhattan, Random Point Group Mobility, and Random Waypoint, all of which accommodate different node speeds. Regardless of the mobility model or speed change, the simulation findings show that DSR provides a steadier and greater UDP throughput than DSDV. Although DSDV works okay when network size is small and mobility is low, its performance suffers as network speed and node density increase because of the increased routing overhead.

Keywords: *Mobile Ad Hoc, Mobility, Throughput, Node, Network.*

I. INTRODUCTION

In MANETs, a type of wireless network that does not rely on a fixed support infrastructure or centralized management, mobile nodes may self-configure and create temporary network topologies on the fly. The nodes that make up a MANET can act as both end systems and routers, passing packets on to other nodes as necessary. Optimization of routing and performance is especially difficult in MANETs due to their extremely dynamic character, which is caused by factors such as node mobility, short transmission ranges, restricted bandwidth, and energy limits. Consequently, there is an urgent need to do research on how MANETs perform under actual mobility patterns, particularly for use cases like emergency response systems, vehicle networks, military communications, and disaster recovery.

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Node mobility has a direct effect on network architecture, route stability, connection length, and packet delivery behavior; as a result, it is one of the most significant elements influencing MANET performance. Route failures and higher routing overhead are common results of nodes' arbitrary mobility, which causes connections to be generated and broken often. Researchers use mobility models, which logically or algorithmically delineate the paths taken by nodes in a virtual setting, to accurately record and examine how node movement impacts the behavior of networks. The validity, trustworthiness, and applicability of MANET performance assessments, especially in studies that rely on simulations, are greatly affected by mobility models.

How nodes move, in relation to other nodes and the environment, as well as their velocities, directions, accelerations, and halt times, are defined by mobility models. From fully chaotic movement to extremely organized and limited patterns, several mobility models try to mimic real-world movement situations. Performance parameters for MANETs, including energy consumption, packet delivery ratio, end-to-end latency, routing overhead, and throughput, are heavily impacted by the mobility model used. Because of this, it is crucial to comprehend the features and consequences of the chosen mobility model, as the results obtained from MANET simulations are very model dependent.

II. REVIEW OF LITERATURE

Mahmoud, Tarek et al., (2014) Unlike traditional networks, mobile ad hoc networks (MANETs) don't require a central hub or other physical infrastructure to establish a communication network. One well-known traffic model for MANETs, the constant bit rate (CBR) pattern consistently generates data packets at a specific pace. Secure end-to-end data stream services on MANETs are made possible by Transmission Control Protocol (TCP). Notable TCP traffic patterns include TCP Selective Acknowledgment (Sack), TCP Vegas, TCP New Reno, and TCP Reno. Any discussion of how well a routing system works must take the traffic pattern into account. Taking into account both CBR and TCP traffic patterns with two distinct mobility models—Reference Point Group Mobility (RPGM) and Manhattan Grid—we investigate the influence of these factors on the behavior of reactive (AODV) and proactive (DSDV, OLSR) routing protocols for MANETs. Measures of efficiency such as packet delivery ratio, average throughput, and end-to-end delay are utilized to assess the protocols that are being investigated. It appears that mobility models and traffic patterns can affect the relative importance of routing protocols, according to NS2 simulator experiments.

Gupta, Anuj et al., (2013) One definition of a mobile ad hoc network (MANET) is a network that does not rely on a fixed infrastructure or central management. Data packets are sent across a wireless media by use of a network of several mobile nodes. Given that mobile nodes can adapt to their environment's topology in real time, a reliable routing protocol is essential for connecting them. In addition, the existing routing protocols all agree that a node's mobility is a key factor in the ad hoc network's overall performance. Consequently, familiarity with the several mobility models and how they influence routing protocols is crucial. This work is an effort to survey the present research state of several mobility models and to compare them. Mobility models, both random and group, are the primary areas of study. We begin with a review of mobility modeling's features, limitations, and

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research issues. Our simulation findings show how important it is to choose a mobility model when simulating an ad hoc network protocol. We also show how a modification in the simulated mobility model has a dramatic effect on the performance outcomes of an ad hoc network protocol.

Zuhairi, Megat et al., (2012) The distribution and movement of nodes throughout a network can be represented using a mobility model. The results of routing performance simulations in Mobile Ad Hoc Networks can be influenced by the choice of mobility model, according to many studies. Thus, a routing protocol's efficacy may be scenario- or model-specific, making it underwhelming in other contexts. This results in flawed reasoning and conclusions drawn from studies of routing protocol performance that are based on insufficient data. This study presents three separate mobility models, each with its own unique behavior when it comes to nodes' movement. The likelihood of route connectedness is also presented as a novel method of measurement. This method measures how often a routing protocol is successful in establishing a route. We compare the outcomes of each mobility model after running extensive simulations.

III. SIMULATION METHOD

Scenario for Different Speed in Mobility Models

From a data rate (Bytes per second) perspective, we have evaluated the efficiency of DSDV and DSR for various speeds using four distinct mobility models: Random Waypoint, Freeway, RPGM, and Manhattan. In NS-2 (version 2.27), you may find the routing protocol that was utilized in the simulation. Mobility Generator, a piece of software that takes the node count, mobility model, and area as inputs and outputs a TCL script for mobility, was used to produce motions for each of these cases. Along with the traffic that we have watched, there is also background traffic that is generated using TCL script.

A waypoint's mobility is specified as Vmax in Random Waypoints. An very mobile scenario is one with a high Vmax. Using an average of ten data connections, we can determine the performance.

Due to the leader's high level of mobility, the other nodes in the group are geographically and temporally linked to his or her movements; hence, in the RPGM model, mobility is defined as Vmax of the leader's. For RPGM, four equal groups were randomly assigned ten nodes each. Every group has a leader chosen at random from among the nodes. Within a 100-meter radius of the group leader, every node stays put. No matter the group membership, the performance is determined by monitoring and averaging 10 data connections.

The freeway mobility model provides a definition of mobility as the maximum permitted velocities for the medium lane, fast lane, and slow lane, which are +10 mtr/sec and -10 mtr/sec, respectively. You may raise the overall scenario's velocity by raising the velocity of the center lane. The first setup used a completely random distribution of nodes across all three lanes.

Using an average of ten data connections, we can determine the performance. Each node in the Manhattan mobility model can have a velocity between zero and Vmax, and it will move at this velocity throughout the scenario, therefore Vmax is the scenario's mobility parameter. Using an average of ten data connections, we can determine the performance.

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Scenario for Different Number of Nodes

Data rate (in bytes per second) is another metric used to evaluate DSDV and DSR performance. This metric is used to systems with 20, 40, 60, 80, and 100 nodes. In this case, we've used the Random Waypoint mobility model and included background traffic as well. The transmission range in each simulation was 250 mtr, and the standard 802.11 MAC layer was utilized. In the simulation, every node possessed an omnidirectional antenna. A 50-buffer-size queue was modelled using the standard CMUPri algorithm. Every 500 seconds, the simulation runs with a different number of nodes. All of the mobility scenarios were designed on a flat 700x700 mtr scenario. The whole topology was two-dimensional since movement in the z-direction was not permitted. The trace that was produced was of the UDP kind. Programs on computers in a network can communicate with one another using datagrams, which are brief messages, using UDP. Datagram dependability and ordering are not provided by UDP. By adjusting the maximum permitted velocity (Vmax) for each mobility model, we were able to calculate the average throughput.

IV. RESULTS AND DISCUSSION

Table 1: UDP Throughput in the Random Waypoint Mobility Model

Speed (m/sec)	UDP Throughput (bytes/sec)	
	DSDV	DSR
10	145.10	252.30
20	126.40	248.90
30	118.75	251.80
40	108.20	244.10
50	102.60	238.40

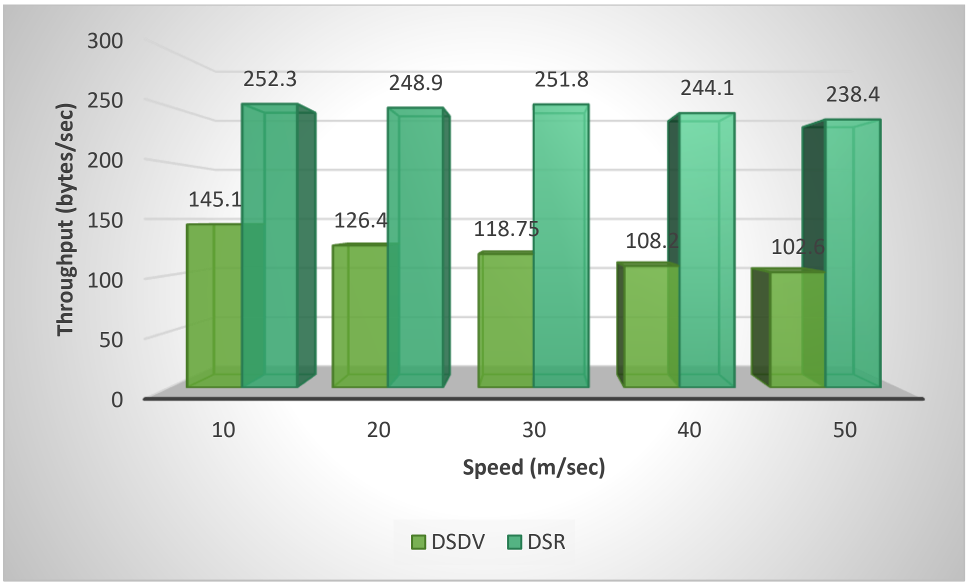

Figure 1: UDP Throughput in the Random Waypoint Mobility Model

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Table 1 shows that DSR outperforms DSDV in throughput at every mobility level. While DSR manages a far greater throughput of 252.30 bytes/sec, DSDV only manages 145.10 bytes/sec at a low mobility speed of 10 m/sec. The throughput of DSDV gradually decreases with increasing speed, reaching a low of 102.60 bytes/sec at 50 m/sec. On the other hand, DSR's throughput drops slightly from 252.30 bytes/sec to 238.40 bytes/sec, which is still pretty constant and greater than its competitors.

Table 2: UDP Throughput Under Random Point Group Mobility Model

Speed (m/sec)	UDP Throughput (bytes/sec)	
	DSDV	**DSR**
10	268.20	257.40
20	165.10	247.80
30	168.30	248.60
40	163.70	244.20
50	149.60	226.90

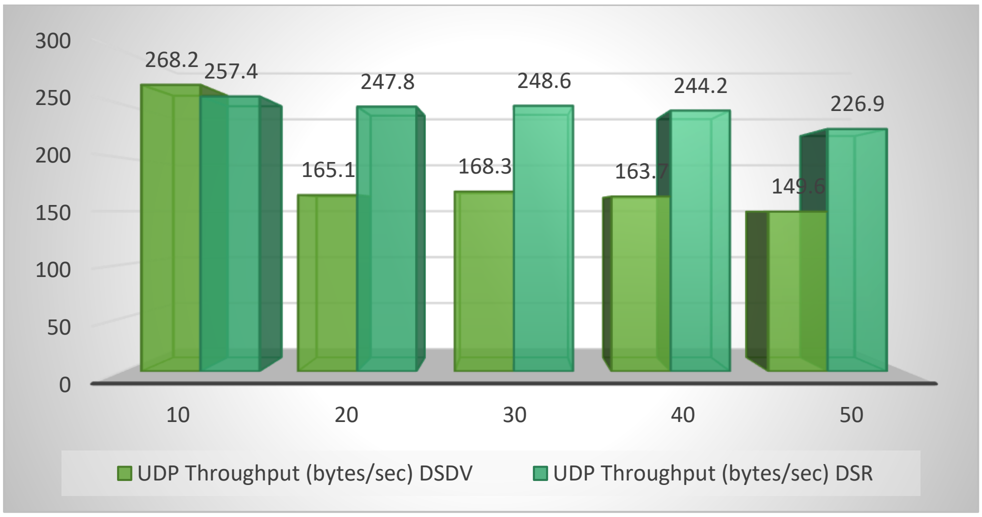

Figure 2: UDP Throughput under Random Point Group Mobility Model

When the mobility is modest (10 m/sec), DSDV achieves a slightly greater throughput than DSR, as seen in Table 2. The DSDV throughput drops dramatically with increasing node speed, going from 268.20 byte/sec at 10 m/sec to 149.60 byte/sec at 50 m/sec. On the other hand, DSR's performance is quite consistent at different speeds; throughput numbers stay high and only slightly drop when mobility levels increase. When it comes to throughput, DSR is on par with or even better than DSDV at medium and higher speeds.

Table 3: UDP Throughput Under Freeway Mobility Model

Speed (m/sec)	UDP Throughput (bytes/sec)	
	DSDV	**DSR**
10	187.30	286.40
20	163.50	245.10
30	142.60	226.90
40	111.20	179.30
50	84.40	149.80

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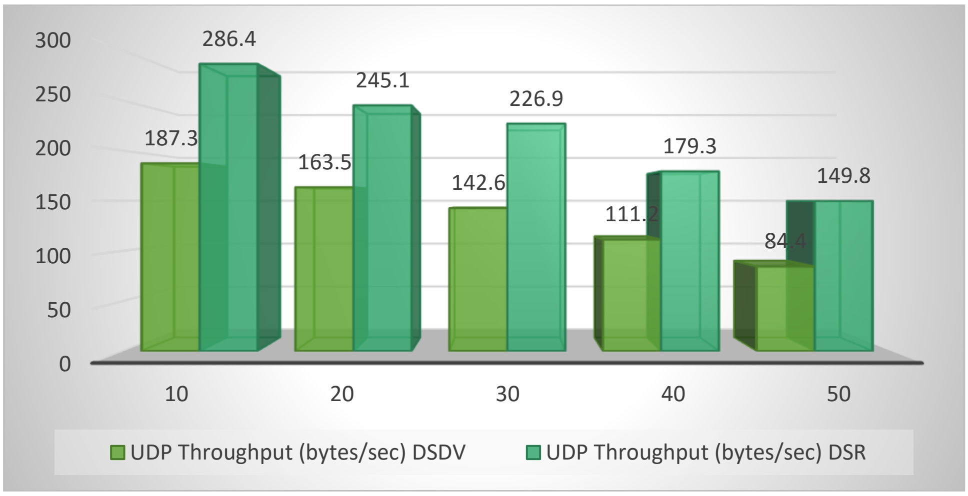

Figure 3: UDP Throughput Under Freeway Mobility Model

According to Table 3, DSR always outperforms DSDV in terms of throughput, regardless of the speed. Distinctly exceeding DSDV's 187.30 bytes/sec, DSR reports a throughput of 286.40 bytes/sec at a slower speed of 10 m/sec. The throughput of both protocols decreases with increasing speed because of the increased frequency of topology changes and route breakages. The performance decline to 84.40 bytes/sec at 50 m/sec is particularly noticeable for DSDV, which experiences a more significant decrease in throughput. Though its throughput drops to 149.80 bytes/sec at top speed, DSR keeps it considerably better throughout.

Table 4: UDP Throughput Under Manhattan Mobility Model

Speed (m/sec)	UDP Throughput (bytes/sec)	
	DSDV	DSR
10	142.90	244.60
20	148.30	250.10
30	109.80	242.30
40	99.40	240.20
50	75.60	238.10

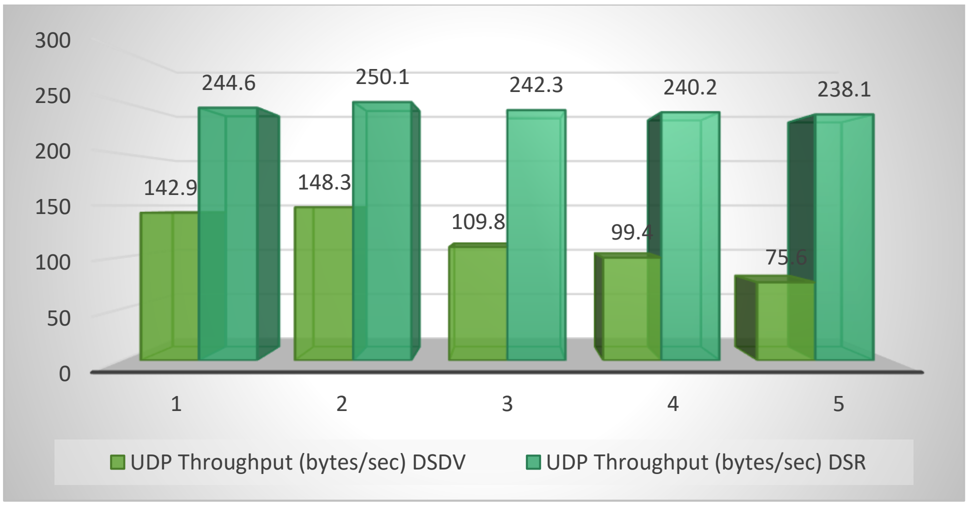

Figure 4: UDP Throughput Under Manhattan Mobility Model

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According to Table 4, DSR always outperforms DSDV in terms of throughput, regardless of the mobility level. While both protocols work admirably at lesser speeds, DSDV reaches its highest throughput of 148.30 bytes/sec at 20 m/sec while DSR reaches a maximum of 250.10 bytes/sec. The throughput of DSDV drops dramatically at speeds greater than 20 m/sec, reaching a low of 75.60 bytes/sec at 50 m/sec. On the other hand, DSR's throughput figures remain rather constant even at increased rates, showing only a little dip from 250.10 bytes/sec to 238.10 bytes/sec.

Table 5: Effect of Number of Nodes on UDP Throughput of DSR and DSDV

Number of Nodes	UDP Throughput (bytes/sec)	
	DSDV	DSR
10	72.40	244.10
20	232.60	250.30
30	214.80	243.90
40	208.10	241.70
50	178.90	239.20

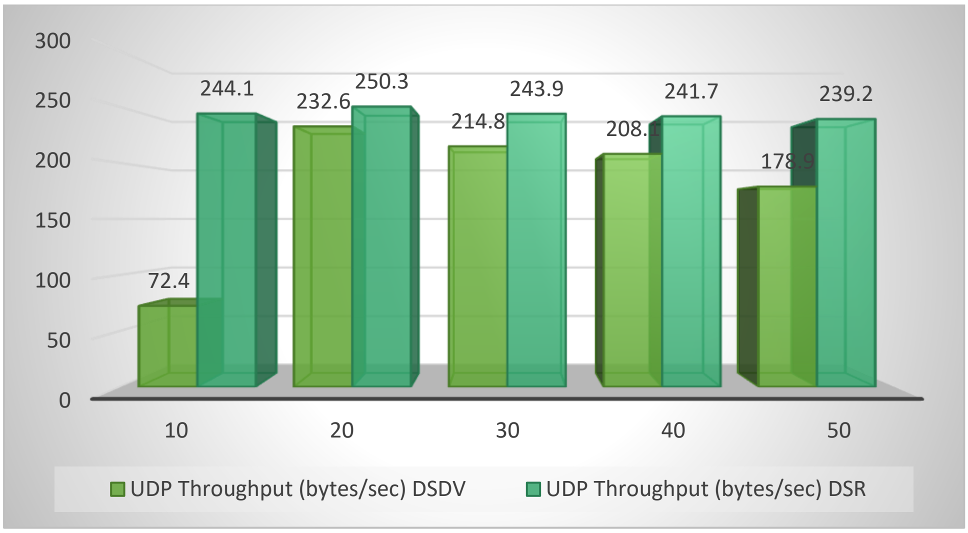

Figure 5: Effect of Number of Nodes on UDP Throughput of DSR and DSDV

Table 5 shows that when the number of nodes is 10, DSR gets a much better value for throughput than DSDV, which is quite low. Both protocols exhibit an improvement in throughput as the number of nodes climbs to 20, with DSR achieving its peak throughput and DSDV displaying a rapid surge. But the throughput of DSDV starts to drop off as the node density exceeds 20 nodes.

V. CONCLUSION

In terms of throughput, DSR consistently beats DSDV across all mobility models and speed levels, according to the data. Even in highly mobile environments, DSR's reactive nature allows it to efficiently adjust to topology changes, leading to better and more consistent throughput. Performance degrades noticeably with increasing mobility and network size because DSDV's proactive routing approach incurs more cost owing to frequent modifications to the routing database. In addition, in

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bigger networks, DSR scales better than DSDV, according to the node density study, preserving strong throughput performance. Over all, the research shows that dense and dynamic MANET situations are better suited to DSR, whereas low-mobility and smaller network settings may be more suited to DSDV. When it comes to MANET deployments, these results are really helpful for choosing the right routing protocols depending on movement patterns and network properties.

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