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# A Study of Mobility Models on MANET Routing Protocol

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***Abstract - A mobile ad hoc network (MANET), a sort of multi-hop network that can manage various types of mobility, does not need permanent infrastructure or central administration. The random mobility of mobile nodes in this network causes continual changes in its design. Protocols are required for dependable node-to-node communication in MANET routing. Routing strategies' efficiency is impacted by several factors. Mobility plays a significant role in the process of choosing a route. In these kinds of networks, routing protocols often make communication between nodes easier. There are two groups into which the MANET Protocols may be divided. One kind of protocol is the routing algorithm with the lowest energy usage. It selects a route that will take the least amount of energy overall to get you where you need to go.***

***Keyword: MANET, Routing Protocol***

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## INTRODUCTION

A mobile ad hoc network, or MANET, is a group of wireless mobile nodes that functions without the need for pre-existing network infrastructure. Each node in the network is free to move around. Messages may be sent and received between the various mobile nodes. The battery life, computing power, size, and transmission range of these nodes may rapidly vary. A small number of nodes in a MANET may be able to switch between functioning as clients and servers simultaneously, depending on the network. It's possible for other network nodes to act as servers. These networks' topology is continuously changing because to the nodes' haphazard, independent mobility. The design as a whole is constantly modified by the random movement of these nodes, which may be changed in a variety of ways. MANET employs two methods to transfer data from the source node to the destination node. If both nodes are in the same transmission range, they may exchange information instantaneously. When direct connection between the source and destination nodes is not available, intermediary nodes are utilized to exchange data.

Natural calamities like floods, earthquakes, and fires may sometimes damage or impair network connections, existing infrastructure, and power. Disasters can be managed more swiftly and effectively if MANETs are deployed immediately. Other recommendations include using MANETs for environmental monitoring and vehicle communications.

## MANET

A mobile ad hoc network, or MANET, has a finite number of wireless mobile connections and is constantly optimized. "Ad hoc" means "Latin and that's why". In remote ad hoc networking, mobile Wi-Fi nodes are used in a network with a complex topology without the use or management of the five networks that are now in place. The mobile ad-hoc community is made up of independent mobile nodes linked by wireless links, with each node serving as both an end system and a router for all other networks. Provided nodes self-organize and operate in random and transient topologies, people and devices may interact without the need for pre-established communication arrangements. MANETs are ad hoc Wi-Fi networks at the connection layer. In contrast to mesh networks, which employ a central controller to create, optimize, and assign the routing table, mobile ad hoc networks use self-healing point-to-point networks. A vast number of MANETs used radio frequencies (30 MHz - 5 GHz) to communicate between 2000 and 2015. Mobile nodes communicate with one another over cellular connections within radio ranges. The network's structure is always shifting since different nodes rely on one another for interaction. Their self-organizing and self-configuring skills are being used more and more in both military and civilian contexts [1].

Protocol routing allows nodes in a network to interact with one another. MANET protocols seem to fall into two primary groups. One potential subset of the protocols is the least power routing strategy. From its

starting point to its ultimate resting place, it takes the most direct path. The group's shortcoming is its propensity to give the shortest half-lives of regulatory pathways priority. The network requires more time to support a second class. Several approaches have been tried to spread the expense of transmission. In order to do this, we may decrease the number of nodes in charge of transmission and let certain nodes to sleep during off-peak hours, thereby lowering the strain on the MANET. Numerous reactive protocols have predicted that MANET would succeed.

MANETs have been a popular lecture topic since the mid-1990s, when laptops and the IEEE 802.11/Wi-Fi wireless network started to spread. Scholarly research has been done on how flexible processes are in constrained settings. The different Protocols may be compared once parameters like packet-to-packet ratio, overhead routing, end-to-end latency, and network transmission are known. [2]

**Types of MANET**

**Vehicular Ad hoc Networks (VANETs):** Vehicles and roadside infrastructure might exchange data using this method. Intelligent vehicular ad hoc networks (In VANETs) are a kind of artificial intelligence designed to help vehicles respond intelligently to potential collisions and accidents.

**Smart Phone Ad hoc Networks (SPANs):** Peer-to-peer networks use the Bluetooth and Wi-Fi capabilities built into widely accessible smart phones in place of cellular carrier networks, wireless access points, and conventional network infrastructure. Unlike Wi-Fi Directs hub-and-spoke architecture, SPANs allow peers to join and leave the network without disrupting its physical components due to a lack of a central authority figure and the ability to handle multi-hop relays. [6]

**Internet based mobile ad hoc networks (MANETs):** Ad hoc networks are those that are created on the fly to link mobile nodes to internet gateways. To create a geographically dispersed MANET, for instance, many sub-MANETs might be combined in a traditional Hub-Spoke VPN. In these networks, traditional ad hoc routing protocols will not operate.

**Characteristic of MANET**

Nodes in a mobile ad hoc network may use highly directional, omnidirectional, or steerable wireless transmitters and receivers. As a result of the nodes' locations, the patterns of their transmitter and receiver coverage, the levels of transmission power, and the degrees of co-channel interference, a "disorganized" or random multihop graph network arises among the nodes. An ad hoc network's nodes' ability to communicate may change over time as a result of factors like migration and other changes. Such networks may be characterized in the ways below:

**Dynamic Network Topologies:** As nodes travel at varying rates, the network's architecture evolves. All of the nodes in a MANET act as hosts and as routers for the network. So it can depend on itself completely.

**Energy-constrained Operation:** The only way to power most modern electronics is via batteries. Power consumption from mobile devices may be reduced by optimizing the network's design.

**Limited Bandwidth:** Wi-Fi networks have a limited amount of bandwidth, thus networks need to be optimized to make the most of that capacity.

**Security Threats:** Wireless networks have less security than their wired counterparts. Increasing the security of the MANET is essential for ensuring the privacy of the sent information. Security, routing, and host configuration all have a distributed component. In this setting, there is no centralized firewall. Eavesdropping, spoofing, and denial-of-service attacks are more likely to occur, so be cautious. When designing protocols, it's important to consider factors like speed and stability that aren't as relevant in the more static, faster architecture of fixed Internet routing. [7-8]

**Multi-hop Radio Relaying:** MANETs may use multi-hop routing to deliver messages when both the sending and receiving nodes are located outside the range of the network's radio signals. A mobile node is characterized by its low storage capacity, limited processing speed, and light weight.

**Bandwidth-Constrained, Variable Capacity Links:** The majority of the time, wireless connections are not as dependable, efficient, stable, or competent as wired ones. This chart illustrates the unpredictable connection bandwidth characteristics of wireless networks.

**Routing Protocols**

In a local area network (LAN), router communication protocols define how routers exchange information and find connections between nodes. There are techniques called routing protocols that may be used to determine the most efficient path. Each router can only anticipate a small number of networks, and those networks must be physically connected. Initially, routing protocols broadcast this data to their close network neighbors. That's why routers could pick up on the network topology. It was with routers in mind that routing protocols were developed. Routers may more readily exchange their routing tables, or lists of known networks, when using these protocols. Different routing protocols can handle networks of different sizes. Ad hoc networks rely on routing algorithms to ensure packets are delivered promptly with minimal overhead and network throughput. [9]

Since all the mobile nodes in a MANET share the same radio frequency, the number of nodes in the network is reduced. Since MANET routing techniques need to be efficient in order to function, this is a top priority. The protocol's main goal is to improve network performance from an application's

point of view, or the needs of the application, while decreasing network costs. You need a high density of nodes, many connections between them, and regular topological shifts if you want your network to be able to serve your application. [10]

## LITERATURE REVIEW

**Ashish K. et al (2010):** To test the efficacy of AODV, FSR, and ZRP routing protocols, they simulated two scenarios. The network was built for the pause time separately using a random adaptability model. Network of randomly chosen nodes, capable of taking on a variety of configurations, [11]

**SreeRangaRaju, et al (2010):** The outcomes of DSR and AODV were compared. Typical elapsed time, packet delivery rate, and throughput are the four output characteristics used to compare AODV, FSR, and ZRP. When comparing AODV, FSR, and ZRP in terms of package delivery rate and quality, the former displays clear superiority. Over 80% of CBR network packets are distributed as a series of nodes as a network time-functionality, and AODV delivers over 60% of these packets. [12]

**AyyaswamyKathirvel, et al (2007):** Examining the strengths of DSR, AODV, FSR, and ZRP as models for propagation. For the reactive riding procedures, there is a high package distribution ratio (AODV and DSR). When compared to proactive and alternative routing protocols, the intermediate routing protocol comes out on top. Latency is reduced in similarly reactive routing methods. [13]

**ShivlalMewada et. al (2012):** Lacking fixed infrastructure, a mobile ad hoc network (MANET) is characterized by its decentralized nature and its tangled nature as a whole. The inherent difficulty of ad hoc networks stems from the mobility of individual nodes. A thorough discussion of the On Demand distance vector, complicated source routing, network size, nudity, and pause-based simulation output analysis, as well as a simulation-based evaluation of MENET's DSR and AODV protocols, can be found in this study. Using NS-2 as a network simulator, the matrix includes data like overall delay and packet delivery ratio. [14]

**Vahid Nazari (2006):** The effectiveness of DSDV, AODV, DSR, and TORA is compared on the NS2 platform, with the results showing that AODV is preferable than the other three in most cases. Scientists found that AODV and DSR operate well under light to moderate network loads, but that the liaison state outperforms reactive methods under heavy traffic. We dug further into the stats for the Basic 5 State Protocol, AODW, and DSR. The authors analyze the impact of real-world simulations by looking at DSR and DSDV. [15]

**Misra and Mandal (2005):** The performance of on-demand protocols was evaluated with the help of AODV and DSR using the Glomosim Simulator. A definitive verdict on the procedures' results is presented by the authors. They anticipate AODV to go beyond DSR, using several data transmission methods to reach various locations. When several sources provide traffic to the same destination, however, AODV's total packet delivery rate likely suffers. You warn that this may lead to issues if conventional entry points are used, and you provide solutions to this potential obstacle. In this project, MANET nodes are all transmitting data to the same place, under the same conditions. Since we run simulations in many different environments, we do not want to either confirm or dispute the authors' conclusions. However, we arrive at our own interpretations of the evidence. [16]

**Demers and Kant (2006):** Ad hoc networks are cellular networks in which no central authority or set of rules has been established. The lack of ad hoc infrastructure severely hinders the usefulness of these networks. For wireless networks that include nodes that are constantly moving, like cellular ad hoc networks, we deploy what is called a Handheld Hoc Network (MANET).[17]

## METHODOLOGY

### Research Design

AODV, DSR, and TORA are the three reactive procedures available for selection. The goal of the thesis is to identify the optimal one for a transient ad hoc network. To achieve the goal, a comparative analysis of these three reactive protocols must be performed in the NS2 simulator with 42 mobile nodes using the two fundamental parameters, packet received and packet loss, and their values must be examined based on various simulation times, packet sizes, and mobility scenarios. Through the use of a network simulator, theoretical research may be realistically verified and implemented. The majority of the researched aspects of the AODV, DSR, TORA, and ABR theories chronically record reactive and hybrid procedure know-how. The MANET routing protocols are compared for packet distribution, overhead routing, output, latency, and power consumption. There are some attractive features of the TORA check compared to other simulators. Three protocols were compared by simulating packet size and mobility after network scenarios were created in Ns2.

- Protocol types for routing.
- Protocols for routing
- MANET reactive protocol description and contrast
- Simulations
- Comparison of AODV, DSR & TORA efficiency metrics

## DATA ANALYSIS

**A Reactive Routing Protocol for MANET:** Reactive Routing Protocol is a bandwidth-efficient on-demand routing technique for MANETs. The process of route search is initiated by the originating node when data is being sent to a destination node. Consequently, the name of the Reactive Routing Protocol comes from the act of looking for a route. The implementation of RRP in mobile nodes' networks will take place at layer 3 of the OSI reference model. Following this, we will go over the features of the protocol that allow for Route Discovery and Route Maintenance.

### 1. Route Discovery

Compared to other alternative on-demand routing protocols, RRP's use of the Incremental Search Strategy means fewer connections need to be searched to get the same routes as with a broadcast-based strategy. Nodes in RRP's Incremental Search Method maintain tabs on their neighboring nodes—those that are directly connected to the source node—through direct communication. In addition to the neighbor's connection cost and discovery time, source nodes also store these details in their neighbor list. The 'Echo' packets are periodically sent out by every node and immediately returned by the node that received them. This allows the network to maintain track of its neighbors. One way to determine the cost of connecting to this neighbor is to divide the round-trip length by two. The neighbor list is useful for more than just route discovery; it may also be used to optimize routing.

### 2. Route Maintenance

To locate and fix broken connections in an accessible manner, RRP uses the Surroundings Repair Method (SRM). Using its routing tables, every node in the Surroundings Repair Method network keeps tabs on the next hop and the hop after that for every target item. When it comes to planning and carrying out tasks, this method works wonders. When a node notices a change in its neighbor list, it starts the Surroundings Repair Method for the routes in its Active Routing Table that use an old neighbor node as their next hop. In response to data packets being unable to be sent due to a degraded connection, the source node initiates the Surroundings Repair Method for any routes in its Active Routing Table that use as their next hop. When a route is fixed, the original node doesn't have to send an invalid packet back and start searching for a new route; this saves overhead. So, Surrounding Repair Method makes MANET more efficient with bandwidth in general. The AODV, DSR, TORA, and ABR routers are all reactive protocol based (ABR).

### Routing Protocols for Reactive Environments

The performance of the routing protocol in an ad hoc network is mostly affected by the speed of the mobile nodes and the design of the network. It is common practice to use 4 "random waypoint layout" to represent node mobility while testing MANET routing protocols. However, in reality, a randomly distributed layout is rather rare. Placing nodes in important areas for the purpose of monitoring is standard practice. A homogeneous layout is a spatial arrangement with randomly distributed elements.

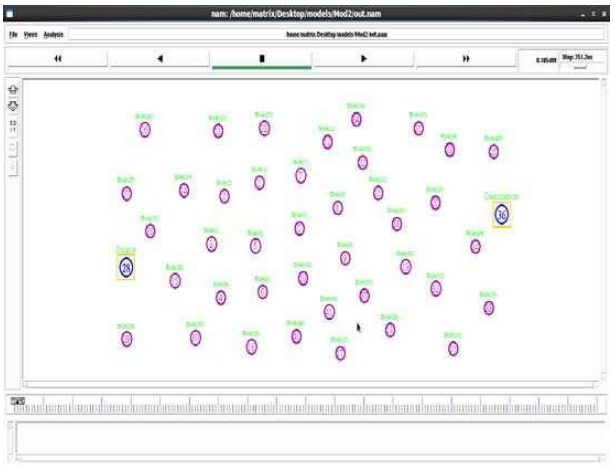

**Figure 1: A Screenshot of Network Animator with 42 Nodes**

### TORA Performance

Just below this table, you can see the performance metric values for 5, 10, 15, 20, and 25 seconds of simulation time.

**Table 1**

| TORA-Simulation Time | | | | | |
|---|---|---|---|---|---|
| Values | PDR | E2E | Rout-Over-Head | Throughput | Egy-Consump |
| 5 | 0.6739 | 458.108 | 62.652 | 2522.96 | 40.8373 |
| 10 | 0.2708 | 1368.4 | 275.175 | 5094.90 | 96.4708 |
| 15 | 0.2793 | 1867.52 | 279.203 | 4632.42 | 108 |
| 20 | 0.2963 | 878.451 | 262.209 | 5162.02 | 108 |
| 25 | 0.3214 | 675.876 | 245.655 | 4765.32 | 108 |

### AODV Performance

Below is a table displaying the values of performance metrics as they relate to packet size.

**Table 2:**

| AODV-Packet Size | | | | | |
|---|---|---|---|---|---|
| Values | PDR | E2E | Rout-Over-Head | Throughput | Egy-Consump |
| 256 | 0.9896 | 32.182 | 0.232 | 332.89 | 21.3221 |
| 512 | 0.9896 | 48.4404 | 0.232 | 332.53 | 33.3037 |
| 625 | 0.9896 | 55.7085 | 0.232 | 332.27 | 38.7326 |
| 712 | 0.9896 | 61.2479 | 0.232 | 332.07 | 42.7442 |
| 850 | 0.9896 | 70.0306 | 0.232 | 331.76 | 49.1433 |
| 1000 | 0.9896 | 79.5817 | 0.232 | 331.42 | 56.0569 |

## CONCLUSION

The results of this study proved that ad hoc networks are useful, very dynamic, and that methods exist to make ad hoc network studies more accessible. In order to bolster further research on research tools

and techniques, the study provides three major contributions. I documented and discussed the actions of three different reactive routing protocols designed for use in ad hoc networks. Knowing how to implement demand and protocol routing strategies will help future protocol designers.

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