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Study on the impact of Mobility Models on the Performance of Manet Routing Protocols

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Abstract - A mobile ad hoc network (MANET) is a sort of multi-hop network that may accommodate various movement patterns without the need for centralized management or permanent infrastructure. In this network, mobile nodes roam at random, and the topology regularly changes. In MANET routing, protocols are crucial for ensuring dependable node-to-node communication. Routing protocols' performance is impacted by a number of problems. One of the most important elements that affect the routing process is mobility. In general, the routing of protocols makes it easier for these networks' nodes to connect. There are two distinct classes of MANET Protocols. Among the protocols, the least power routing algorithm is one. It selects a route that minimizes the amount of energy used overall from source to destination.

Keyword - MANET; routing protocols

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INTRODUCTION

Mobile Ad hoc Network (MANET) is a collection of wireless mobile nodes that does not need any prior network infrastructure. All network nodes have complete freedom of movement. Messages may be sent and received between the various mobile nodes. When it comes to battery power, computational capabilities, size or transmission range these nodes may swiftly vary. Some nodes in MANET may act as clients, while others can act as servers, and a small number of nodes may be able to switch between serving as both clients and servers at the same time, depending on the network. Because the nodes in these networks move randomly and independently, the topology is always changing. There are a variety of ways that these nodes may be relocated, and their random movement alters the overall topology dynamically. MANET relies on two mechanisms to transport data from the source node to the destination node. If both nodes are in the same transmission range, they may instantaneously share information. If the source and destination nodes don't communicate directly, intermediary nodes are utilized to exchange data.

Natural catastrophes such as floods, earthquakes, and fires sometimes result in the destruction or degradation of network connections, existing infrastructure, and power. Disasters can be dealt with more swiftly and effectively if MANETs are implemented immediately. There are other plans to use MANETs in environmental monitoring and vehicle communications.

MANET

MANET is a mobile ad hoc network with a limited number of mobile wireless connections that is constantly optimized. "Latin and that's why" is what "ad hoc" implies. Mobile Wi-Fi nodes are used in a complex topology network without the usage or management of existing 5 networks in remote ad hoc networking. Each node in the mobile ad-hoc community serves as both an end system and a router for all other networks, forming a stand-alone community of mobile nodes linked by wireless links. Users and devices may interact with each other without the need for pre-existing communication plans if nodes arrange themselves and operate in random and temporary topologies. Ad-hoc Wi-Fi networks at a connection layer are known as MANETs. The self-healing point-to-point network is used in mobile ad hoc networks, as opposed to the mesh network, which has a central controller (to establish, optimize, and allocate the routing table). During the period of 2000-2015, a large number of MANETs communicated using radio frequencies (30 MHz - 5 GHz). Inside radio ranges, mobile nodes communicate with one other through cellular connections. The topology of the network is constantly changing due to the fact that various nodes rely on each other to communicate. In both military and civilian contexts, their self-organizing and self-configuring capabilities are increasingly being used [1].

Protocol routing helps to link the network's nodes together. Protocols in the MANET may be divided into two distinct classes. Among the protocols, one may find the minimum power routing method as a subset. It takes a path that uses less energy overall,

from the source to the destination. This group's drawback is that it often selects control pathways with the shortest lifespans. In order for a second class to take place, the network must have more time. A variety of routes are tried to spread out the transmission charge. Reduce the number of nodes required for transmission duties and enable a portion of nodes to sleep at different periods in order to achieve this goal this reduces the amount of traffic in the MANET and extends the life of the network. The success of MANET has been predicted by a number of reactive protocols.

The proliferation of laptops and the IEEE 802.11/Wi-Fi wireless network has made MANETs a popular course topic since the middle of the 1990s. Some academic studies examine procedures and their abilities in terms of adaptability in a confined space. Such factors as packet propagation ratio, overhead routing, end-to-end latency, and network transmission may then be used to assess the different Protocols. [2]

MANET Routing Protocols

Many years have passed since the MANET routing protocol was critically examined. Routing protocols based on topology and placement is among the options under consideration.

Topology-Based Routing Protocols

A topology-based routing protocol encapsulates network access information in packets. As a result of the frameworks used to update their hybrid (or proactive), reactive (or on-demand) protocols in this section, the MANET control mechanisms are described here in this grouping. For examining the impact of prior investigations, the technique is often known as flood protocols. [3]

Proactive Routing Protocols

Routing information pairs in transmission tables are measured by proactive routing techniques. As a result of the way pathways is computed independently of the requirement to convey data, this kind of protocol has low communication latency. It's expensive to maintain, particularly when routing information is required to conform to the evolving topology. Examples of beneficial routing protocols are the DSDV (Destination Sequenced Distance-Vector Protocol) and the OLSR (Optimized Link State Routing protocol) [4].

Reactive Routing Protocols

Routine modifications, such as increasing the amount of time spent in transit, are examples of how proactive protocols build on the foundations of conventional routing algorithms. Using data packets that are ready for contact to identify routes was proposed as a novel MANET routing mechanism. Reactive protocols, in which paths are only computed when required, are based on this principle. In exchange for a lesser overall view and a cheaper cost of transmitting request packets, this protocol style is used. Due to this delay in finding routes and the path being stored inside the same node pair, more late reactive protocols are used. AODV (Ad Hoc On Demand Distance Vector) and DSR (Dynamic Source Routing) are two examples of on-demand protocols in MANET. [5]

Hybrid Protocols

Hybrid routing processes, as opposed to reactive or proactive protocols, have the potential to improve scalability. With the goal of keeping routing information intact, it strives to reduce the number of nodes involved in the retransmission process. Area Routing Protocol (ARP) is a common hybrid protocol with a zonal design that avoids inter-zone overhead. ZRP aims to address the shortcomings of both constructive and reactive routing protocols by combining the best characteristics of each. Each node on the network has a routing zone configuration with a radius, which is expressed in a hop count. An IARP, an IERP, and a protocol for border cast resolution make up the three parts of this system. There are three parts to the IERP: (BRP). Nodes in the network's routing region use the IARP family of pragmatic protocols to store their routing information. Additionally, IERP is a family of reactive routing protocols, which improves route discovery and management services. 12 focused on local connection monitored by IARP. The zone ray has a substantial impact on the output of ZRP for a given node density. For the sake of maintaining zonal vision, the reasoning is that ZRP minimizes latency and interzone node overhead. ZRP's overhead is often exacerbated by the presence of places where there is a lot of overlap. It has not yet been applied the ns-3 updates. [6]

Position-Based Routing Protocols

It's possible to overcome some of the "topology-based routing shortcomings "'s by using extra location information. In contrast to topology-driven routing systems, they decide on regional node co-ordinates given by GPS or other placement departments. In position-based routing protocols, there is no need for traditional routing and maintenance. To store and update routing tables and other information, there are nodes that are not needed. They may also be more successful than high-tech routing methods in exceedingly complicated scenarios.For location-aided routing (LAR) and quick trajectory transfer, the ResiliNets community has designed ns-3 routing protocols (SiFT). The comparative examination of MANET routing protocols will be completed in the future. Topology-focused routing techniques are the topic of this study.[7]

Temporally-Ordered Routing Algorithm –TORA

Protocol for distributed execution of a time-ordered temporary routing algorithm (TORA), a family

connection algorithm is the underlying algorithm. Designed to minimize the effects of topological changes, TORA is an effective tool. An important architectural principle is that control signals be kept to a minimum. This eliminates the possibility of a path having any loops, and it often gives several paths to each destination and source. The Internet MANET Encapsulation Protocol is used to route all underlying functions in the architecture (IMEP). [8]

Road building, maintenance, and removal will all fall within the purview of TORA. For an undirected network or a section of an undirected network, the design of routes gives rules for the inclusion of a driven acyclic graph (DAG).

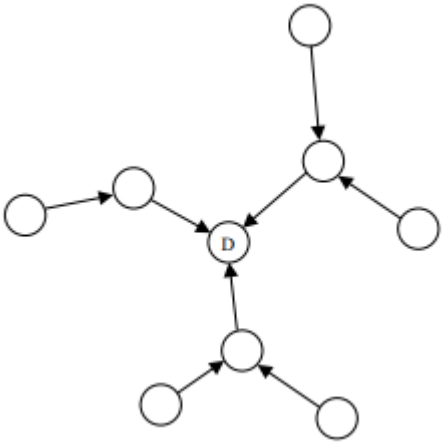

Figure1: A directed acyclic graph rooted in the destination.

With a height, TORA matches any node on the network. Messages go from the highest node to the lowest node in a network. Routes are demonstrated to utilize the QRY to update packages. We've figured out how to get here. A QRY packet will be sent to a destination if a node with no downstream connections can reach it. There is a good chance that this QRY packet will propagate throughout the network before it reaches its final destination. Once the node height has been determined, a UPD packet is sent to that node. Upon receiving this UPD packet, all nodes are set to a higher level than that provided in the UPD message. A UPD packet is then sent from this node. As a result, the person who sent the QRY packet is in a position of power. It is possible to take a variety of routes to get here.

As a result, roads are maintained in such a way that they may be restored quickly to their goal so that the directed regions return in a target-oriented diagram within a limited period of time. All connections in the network segment separated from the objective are unlisted if the network division is identified, to eliminate invalid routes. Clear notifications may be used to eliminate routes (CLR).

DSR (dynamic source routing)

Using eavesdropping (promiscuous mode), this DSR application is able to monitor every traffic it hears. The question is whether or not this is feasible in the real world. Perhaps IP-Sec is used in real-time circumstances to transfer communications, potentially through IP-Sec. To enable and off the eavesdropping feature, we made a little change to the DSR. An example of this is when a node waits for a search result without propagation. When a search is not propagated, it is sent to the closest nodes first. Residents will submit a new application if they don't get a response from their neighbor's throughout this time frame. 60 packets may be sent to the DSR submit buffer at a time and packets can stay in the buffer for 30 seconds.[9]

Routing Protocols in MANET

For data to be sent from one node to another in the MANET, a path must be established. When the source node and the destination node are not within the same range, the intermediate nodes help the communication between the nodes succeed. Routing protocols play a critical part in determining the most efficient method of transporting data. Routing protocols utilize a variety of techniques and metrics to identify the best route for transmitting packets between nodes. However, most of these are dependent upon the network structure and routing technique and are used to categories MANET routing protocols. Multi-hop pathways and data exchange between nodes must be maintained by the wireless node in order for it to function. One of the most important aspects of the communication process is the creation of a routing protocol. As part of this subject, we'll go through three MANET routing protocols and a few associated concerns.

A. Ad-hoc on-Demand Distance Vector (AODV) Protocol

Ad-hoc On-Demand Distance Vector (AODV) Protocol is one of the most often utilized reactive MANET routing protocols. Multicast and unicast routing between mobile nodes in the network is supported by this protocol. AODV can only keep track of the routes that are really being utilized. In order to limit the amount of broadcast messages, AODV plays an important function. Route Request, Route Reply, Route Error, and HELLO Messages are just a few of the messages AODV employs to locate and manage routes. Source nodes must find a way for packet transfer when they wish to transmit packets to a destination node but do not have the routing information to reach the destination or when a previously valid route has expired. Route Request Message (RREQ) is used to send this request to all of its neighbors.

One of the four messages that the source node uses to discover the routes is the RREQ message. Once this message reaches its target, it will continue to spread around the network. In addition to the source and destination addresses, RREQs

include the Request ID, Source Sequence No and Destination Sequence No, Hop Count fields. The source node receives a unicast Route Reply (RREP) message if any of the neighbor nodes have a route to the destination node. Other nodes will get an error message instead of the RREQ message if it rebroadcasts it. RREQ messages from a neighbor are received by a node and the neighbor's address is recorded. The nodes use this address to locate the final node. By using this method, nodes in the network may send fewer broadcast messages. In addition to the source and destination addresses, the RREP also includes the destination sequence number, hop count, and life time of the connection.

LITERATURE REVIEW

Mobile Ad hoc Networks: an overview

Demers and Kant (2006): The term "ad hoc network" refers to a cellular network in which no centralized network infrastructure has been established. The lack of ad hoc infrastructure is causing major issues with these networks. For cellular ad hoc networks with mobile nodes, we employ a Handheld Hoc Network.[17]

Zahary, Ayesh, (2007): It is important to consider the energy consumption of nodes, topology alterations, inconsistent connection and restricted bandwidth while developing MANETs because of their node variety. MANET enables mobile nodes to operate as routers and hosts, allowing them to receive and transmit data from their neighbors. Network self-configuration difficulties grow as the network expands and nodes become more flexible. To save battery life, mobile nodes may use fewer resources by connecting and preassembling more often. Ad hoc routing protocols are developed to cope with the complexities of MANETs. The effectiveness of the routing method is influenced by the utilization of participating node battery capacity and node routing, among other factors. How rapidly the routing protocol adjusts to connection ripping and mending is also referred to as crucial. ZRPs include Ad-Hoc Routing Protocols (ZRPs) such AODV (AODV), OLSR (OLSR), DSR, TORA, Wireless Routing Protocol (WRP) and Zone Routing Protocol OLSR, AODV, DSR, and TORA are all discussed in this paper in a simple manner.[18]

Routing Protocols

Alex Hinds et.al,. (2013): The AODV core protocol provides multicast support for monitoring the progress of an AODV protocol by verifying work based on an ad hoc on-demand distance vector (MAODV) Multicast. For example, the security-conscious ad hoc on-demand distance protocol author analyzed and advised revisions to literature on the safety of the AODV protocol (SAODV). [19]

Dr. V.V.Rama Prasad et. al. (2012): One of the MANET research areas of emphasis was routing. Which led to the development of a number of different routing protocols for MANETs? Reactive protocols for unicast and multicast routing are described and analyzed by the author. On demand routing methods determine when it is necessary. It's not necessary to make frequent changes. Regular photographs may be necessary for any nodes. ABR, for example, CBRP is the exception to the rule when it comes to reactive protocol routing topologies. GPS has raised the amount of traffic control, which is lower than the volume of global routing. For example, there is LAR. ABR uses LBQ to deal with the problems that come with being so adaptable. ROAM employs a lowered threshold. AODV employs a technique known as "local path exploration" to find the most efficient route. A reactive protocol storage requirement is determined by the number of tracks that are maintained or are needed to be stored. Pacing is often slower for reactive methods, whereas proactive ones typically have higher pause ratios. For source routing processes, the scalability relies on traffic volume and the number of knots of multi-hopping. [20]

Anurag Malik, et. al. (2011): Many existing routing protocols were outlined in detail, with a focus on their characteristics and capabilities. Routing and routing decision-making methods are often compared. The performance of all routing protocols is also the subject of debate. Smartphone ad-hoc routing techniques were examined and compared in this work. Prototypes may be categorized into three main groups: One of the protocols (ii) the pro-active and two of the pro-active are begun from root. Routing protocols each have their own unique set of characteristics. Network circumstances dictate which routing protocol should be used. It has been shown that the inherent characteristics of mobile networks, such as a lack of resources and an ever-changing topology, make safe routing even more difficult. When it comes to finding and maintaining routes between source and destination pairs, the protocols range greatly. Most of the protocols in this article have unique features and settings that make their competition better. [21]

Sunil Tanejaet. al. (2010): With each packet is an additional layer of security: a new authentication service and a correspondingly higher degree of trust in the authentication service. The effective dissemination of routing information is critical to the success of ad hoc network activities. The routing protocol is vulnerable to attacks from rogue nodes. As a result, safeguarding routing protocols is of paramount importance. Authentication methods may be routed across an ad hoc network with just 30 overheads, according to the author. Foreign intruders are prevented from attacking the network by using the DSR routing protocol, which is intended to identify and correct common misunderstandings about the network's nodes. Because of the routing protocol's adoption of the scheme, its performance is not significantly hampered. [22]

METHODOLOGY

Research Design

There are three reactive protocols to choose from: AODV, DSR and TORA. The thesis aims to determine which one is the best for a short-lived ad-hoc network. A comparative analysis of these three reactive protocols has to be carried out in the NS2 simulator with 42 mobile nodes based on the two basic parameters packet received and packet loss and examining their values based on the different simulation time, packet size, and mobility scenarios in order to meet the objective., Theoretical studies may be practically validated and put into practice via a network simulator. Reactive and hybrid procedure know-how is chronically recorded by studied details of the AODV, DSR, TORA & ABR theory, most of which are MANETs-friendly. For packet distribution, delay, output, overhead routing and power consumption of MANET routing protocols are compared. In comparison to other simulators, the TORA check has a number of appealing characteristics. Following the creation of network scenarios in Ns2, packet size and mobility were simulated in order to compare three protocols.

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

DATA ANALYSIS

Description of Reactive Routing Protocols in MANET

An on-demand routing mechanism for MANETs, Reactive Routing Protocol is bandwidth efficient. When sending data to a destination node, the originating node commences the route search process. As a result, the Reactive Routing Protocol gets its name from the process of searching for a route. The OSI reference model's layer 3 is where RRP will be implemented in mobile nodes' networks. Next, the protocol's Route Discovery and Route Maintenance capabilities are explained.

1. Route Discovery

Due to its usage of the Incremental Search Strategy, RRP differs from other optional on-demand routing protocols in that less links must be searched in order to find the same routes as with a broadcast-based method. There are nodes in RRP's Incremental Search Method that keep track of their immediate neighbors those nodes that have a direct communication connection with the source node. The connection cost to this neighbor, and the moment at which it was discovered, are likewise recorded by source nodes in their neighbor list. In order to keep track of its neighbors, each node sends out periodic 'Echo' packets, which are instantly returned by the node that received them. The connection cost to this neighbor may be calculated by dividing the round-trip duration by two. Routing improvements may be made using the neighbor list, which is not simply for route discovery but can also be utilized for other reasons.

2. Route Maintenance

RRP employs the Surroundings Repair Method (SRM) to find and repair broken links in an accessible way. Each node in the Surroundings Repair Method network maintains track of the next hop and the next to the next hop for each target item in its routing tables. This approach is effective both in the planning stage and in the execution phase. Whenever a node detects a change in its neighbor list, it commences the Surroundings Repair Method for those routes in its Active Routing Table that utilize as a next hop an old neighbor node. Reactively, when the source node can't forward data packets because of a broken connection, it commences the Surroundings Repair Method for all those routes in its Active Routing Table that utilize as their next hop. If a route is successfully repaired, the overhead of sending a route invalid packet back to the originator node and beginning a fresh route search by the originator node is saved. As a result, Surrounding Repair Method improves MANET's overall bandwidth efficiency. Routers based on reactive protocols include AODV, DSR, TORA, and ABR (ABR).

Implementation of Reactive Routing Protocols

Mobile nodes' speed and network architecture are the primary elements that impact routing protocol performance in an ad-hoc network. 4 "random waypoint layout" is often utilized as a node movement model in MANET routing protocol tests. A random and evenly dispersed layout is unusual in the actual world, though. It is common practice to put nodes in strategic locations for the sake of monitoring. Homogeneous layout is the term used to describe a randomly dispersed spatial plan.

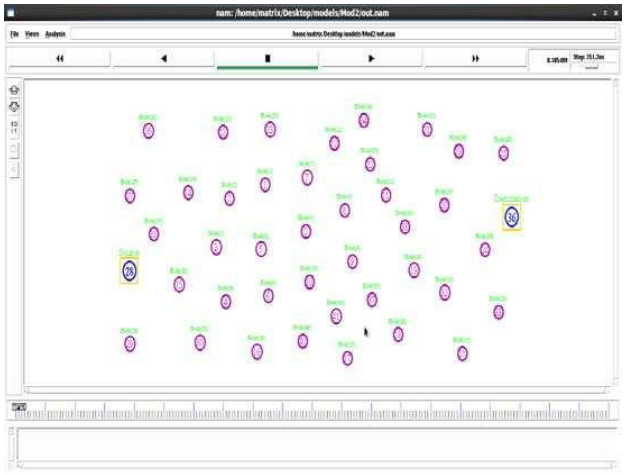

Figure 1: A Screenshot of Network Animator with 42 Nodes

TORA Performance

A table of performance metric values with respect to simulation time5,10,15,20 and 25 seconds was created and shown below table.

Table 1: TORA – Simulation Time

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

A table of performance metric values with respect to packet size was created and shown in below table.

Table 2: AODV – Packet Size

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

This study demonstrated that ad hoc networks are practical, highly dynamic, and that techniques for making ad hoc network research more understandable to others may be developed. The study makes three significant contributions to help support ongoing research on research tools and methods. I compared three reactive routing approaches for ad-hoc networks and found and explained behavior in each protocol. Future designers of new protocols should benefit from understanding techniques on demand and protocol routing.

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