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Analyzing the Efficiency of Geographical vs. Non-Geographical Routing Protocols in MANETs: A Case Study on LAR, AODV, and DSR

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Abstract: Mobile Ad Hoc Networks (MANETs) require effective routing protocols in order to guarantee uninterrupted communication in situations that are both dynamic and devoid of infrastructure. The purpose of this research is to analyse the performance of geographical and non-geographical routing protocols by conducting a comparative analysis of Location-Aided Routing (LAR), Ad hoc On-Demand Distance Vector (AODV), and Dynamic Source Routing (DSR). When it comes to optimising path selection, LAR makes use of location information, whereas AODV and DSR adhere to more conventional reactive management strategies. Under different mobility and network density situations, the study takes into consideration important performance indicators such as the ratio of packets delivered to the endpoint, the latency from beginning to finish, the routing overhead, and the energy efficiency. AODV and DSR show resilience in situations when there is inadequate location information, as demonstrated by the outcomes of the simulation. LAR, on the other hand, minimises the latency and overhead associated with route discovery. Using the data, one may get insights into selecting the most appropriate routing protocols for MANETs, taking into account the limits of the network and the operational requirements.

Keywords: MANETs, Routing Protocols, Geographical Routing, LAR, AODV, DSR, Performance Analysis

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INTRODUCTION

Mobile Ad Hoc Networks, also known as MANETs, are networks that are self-configuring and do not require any particular infrastructure. They are made up of mobile nodes that connect wirelessly. Military operations, disaster recovery, vehicle networks, and remote sensing applications are just some of the many areas that make extensive use of MANETs because to its decentralised structure. When it comes to creating effective routing protocols, however, MANETs present a number of important issues due to their dynamic topology and limited energy resources. Geographical and non-geographical (topology-based) categories are two major categories that may be used to classify routing protocols in MANETs. Locate-Aided Routing (LAR) is one example of a geographical routing protocol that makes use of location information in order to improve route discovery and minimise control overhead that is not essential. While non-geographical routing protocols, such as Ad hoc On-Demand Distance Vector (AODV) and Dynamic Source Routing (DSR), rely on topology-based techniques to construct communication pathways between nodes, geographical routing systems rely on physical topology. In terms of packet delivery ratio, end-to-end latency, routing overhead, and energy consumption, the choice of routing protocol has a considerable influence upon the performance of the network. Furthermore, topology-based protocols may offer better flexibility in contexts where location information is either absent or inaccurate. Geographic routing is anticipated to improve efficiency by restricting route discovery to regions that are relevant to the problem at hand. Through an evaluation of their performance under a variety of mobility and network density settings, the purpose of this research is to analyse and evaluate the effectiveness of LAR, AODV, and DSR in MANETs. Using the findings of the study, which guide the selection of routing protocols for real-world MANET applications, the study gives insights into the advantages and limits of each strategy.

RESEARCH METHODOLOGY

Evolution Of Manets

The following is a list of some of the specialised areas that are being explored here: Cybercrime can be defined in a variety of ways; it is distinct from traditional crime in a number of ways; it poses a threat to the data systems of the government; it is linked to terrorism; it is essential to safeguard personal information; the government's law enforcement agencies respond to cybercrime; and there are relevant laws conventions that address this issue. Government agencies and non-profit research organisations in a number of countries that were taken into consideration have contributed to the publication of critical evaluations of the most important problems associated to cybercrime. On account of the significance of the findings obtained from these studies, it is necessary to incorporate them into this report as well.

Benefits of MANETs

- They are simple to put into action.
- The upkeep is not difficult.
- It is possible to communicate while moving about.
- The establishment of a communication infrastructure does not require any additional costs to be incurred.

Challenges of MANETs

Current research is centred on finding solutions to the problems that MANETs are experiencing. An inventory of the challenges that are brought about by MANET is presented below:

Security

The security of MANETs is a challenging task. In comparison to a wired connection, a wireless link is more susceptible to faults, risks, and eavesdropping than the wired connection. When it comes to mobility and wireless communications, the addition of security is a more challenging endeavour to undertake.

Routing

The implementation of routing in MANETs is a difficult activity to do. In the process of moving data from one location to another, routing is the act of determining the most efficient path to take. When each node in the network functions as a router, the management of the network becomes harder to do. The difficulty emerges as a result of the fact that every node in the network is travelling in any direction regardless of its direction. When a node moves, a fresh window of opportunity to locate and select the best possible path opens up; however, this window of opportunity is only available for a short amount of time.

Scalability

Network and packet sizes are extremely important to the operation of MANET. The size of the network has a considerable impact on forwarding, which in turn makes it more challenging to route and locate suitable paths. In the context of a network, scalability refers to the capability of the network to accommodate a rising number of users and data without affecting the quality of service.

Quality of Services

It is not an easy task to keep up with high quality of service (QoS) requirements when construction is taking place. The dynamic nature of a MANET makes it challenging to achieve satisfactory performance in this type of network. Depending on the degree of service that is required by the customers, the network would give the ideal level of service. Bandwidth, jitter, and latency are three metrics that may be used to understand performance. It is a challenging endeavour to maintain the quality of these measures when operating in mobile situations. A shortened summary of other topics that are similar but more important is presented in the following paragraphs.

Unpredictable Link Properties

The dependability of wireless connections is highly dependent on a variety of factors and is prone to change. Degradation in signal quality may occur due to fading, interference, and other circumstances. Because of these characteristics, the outcomes of the latency and bandwidth tests will be affected.

Node Mobility

Because the mobility of nodes frequently causes changes to the architecture of the network, the routes are constantly being modified. The greatest distance that a signal may travel between two nodes is something that is impacted by the mobility of the nodes. As a result of the possibility that shifting nodes may result in a connection failure, the packet loss rate retransmission may become more severe. Mobility has an effect on some factors, like channel access, routing, and others.

Limited Battery Life

When it comes to MANETs, power consumption is a significant problem. There is a limit to the amount of power that can be extracted from the batteries in mobile devices. The lifespan of the entire network is reduced as a consequence of the power consumption of the device.

Route Maintenance

It is extremely challenging to consistently store network status information in MANETs because of the fluctuations in the performance of the communication channel that are brought about by the dynamic topology of these networks. This indicates that MANET routing algorithms are unable to deal with data that is erroneous. When data is being sent in a MANET, connection failures are possible because of the high number of instances in which nodes enter and depart the network.

Limited Bandwidth

When compared to conventional networks, wireless connections have a significantly lower amount of electricity.

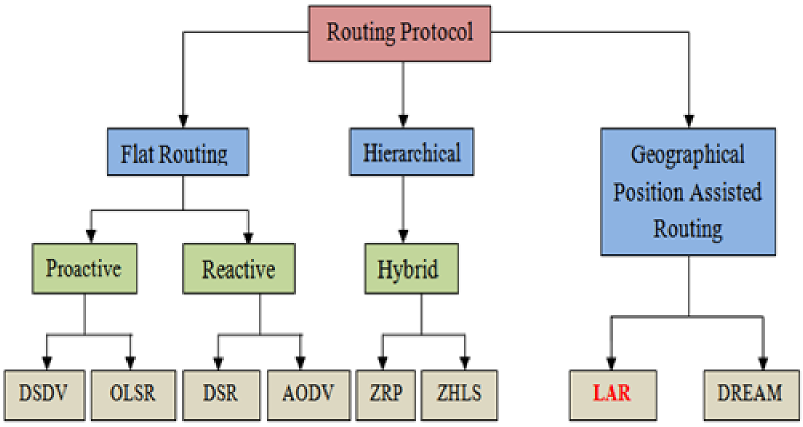

Figure 1: Taxonomy of Routing Protocols

OBJECTIVES OF THE STUDY

1. To Get an overview of ad hoc networks MANET
2. To evaluate how well the geographical routing protocol LAR performs in MANETs in comparison to the non-geographical routing methods AODV&DSR.

EXPERIMENTAL STATISTICAL VALIDATION

Integrating Power Saving Mode Into Lar Protocol To Minimize Energy Consumption In Manets

For the purpose of connecting a network of nodes, a MANET makes use of radio frequency communications. Because these nodes are able to move freely in an environment that is always shifting, the architecture of the network is constantly evolving. It might be a nuisance to have to recharge the batteries of the nodes. The effectiveness of the battery's utilisation is directly proportional to the efficiency with which the nodes use energy. It is possible that the efficiency of the routing protocol will determine the amount of electricity that mobile nodes consume. LOR, DSR, and the non-LOR implementation of AODV are the three distinct routing protocols that have been examined. There are three modes that EXata investigates: gearbox, reception, and idle power consumption.

First things first, the so-called "traditional LAR protocol" has been put through a series of rigorous tests across a wide range of network configurations by means of the EXata simulator.

Comparative Analysis of Geographical (LAR)&non-geographical routing protocols (AODV, DSR) in MANETs

The purpose of the simulation is to assess the existing protocols, namely AODV, DSR, and LAR, using a network size of sixty nodes that are dispersed throughout a 1000 × 1000 m2 area. The simulation will ensure that the speed, simulation length, and pause time remain consistent throughout the process. Through the use of the Random Waypoint Mobility Model, mobility is provided to each and every node that is included in the scenario. Version 5.4 of EXata was utilised in order to carry out the simulations.

Performance Results

Figures 2, 3, 4, 5, 6, and 7 illustrate the metrics that were utilised during the process of evaluating the performance of LAR in MANETs in comparison to AODV and DSR. The average end-to-end delay, throughput, energy consumption in transmit and receive modes, and total energy consumption are several metrics that are included in this category. When compared to AODV and DSR, the simulation results demonstrate that LAR consumes the most energy overall, despite the fact that it has a low latency and a tremendous throughput on average.

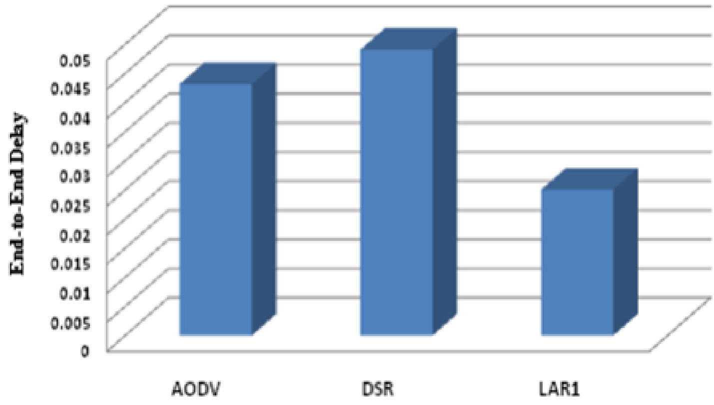

Figure 2: Variation in End-to-End Delay for AODV, DSR&LAR1 at 60 Nodes

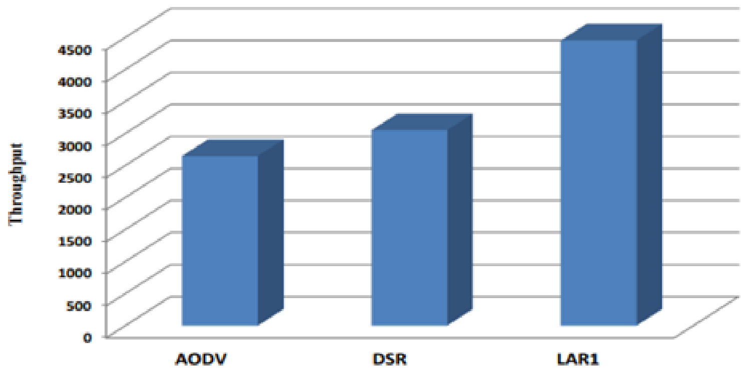

Figure 3: Variation in Throughput for AODV, DSR&LAR1 at 60 Nodes

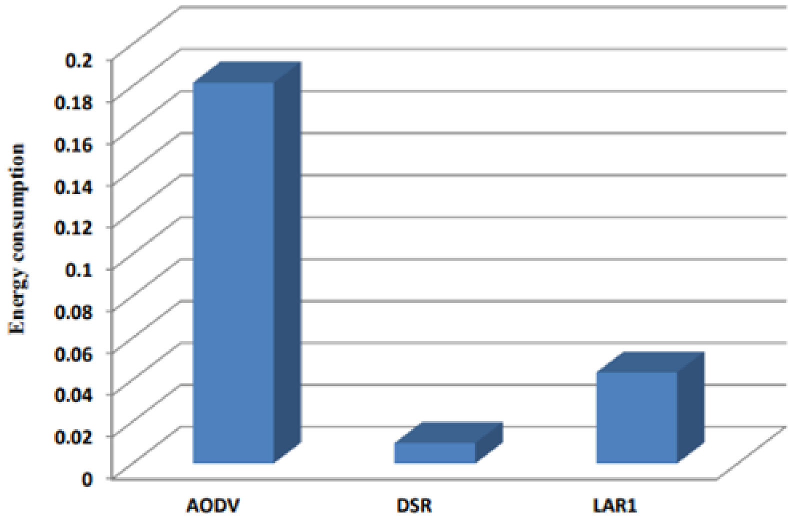

Figure 4: Variation in Power used during transmit mode for AODV, DSR&LAR1 at 60 Nodes

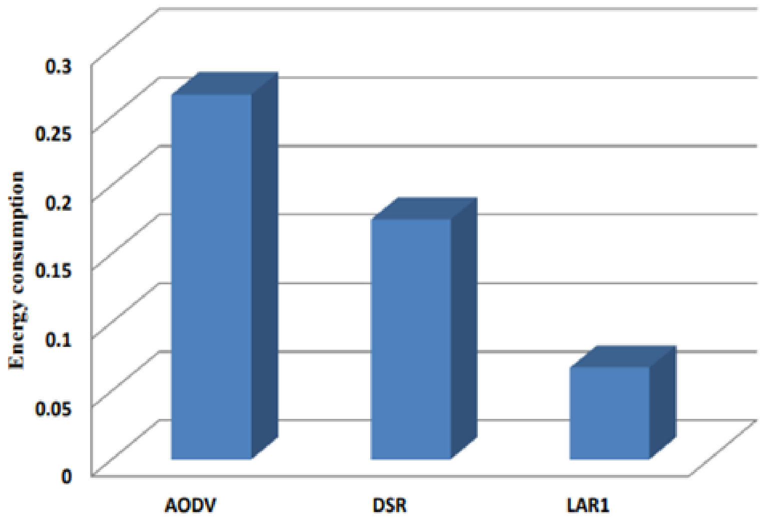

Figure 5: Variation in Power used during receive mode for AODV, DSR&LAR1 at 60 Nodes

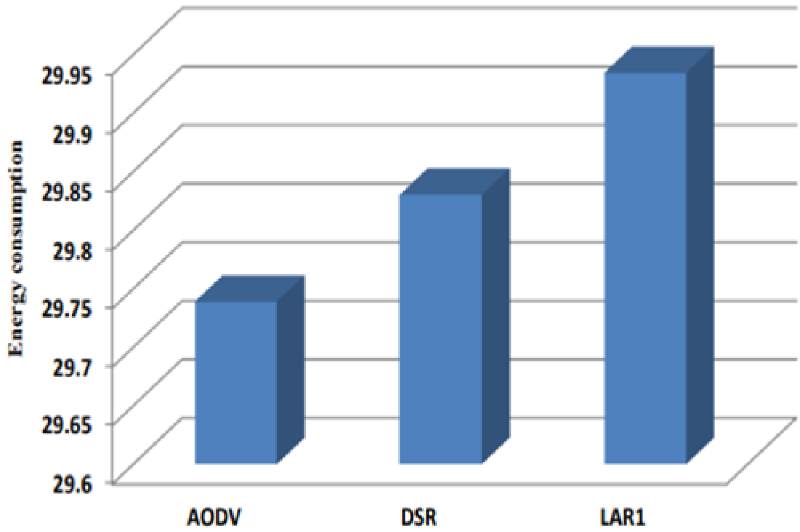

Figure 6: Variation in Power used during idle mode for AODV, DSR&LAR1 at 60 Nodes

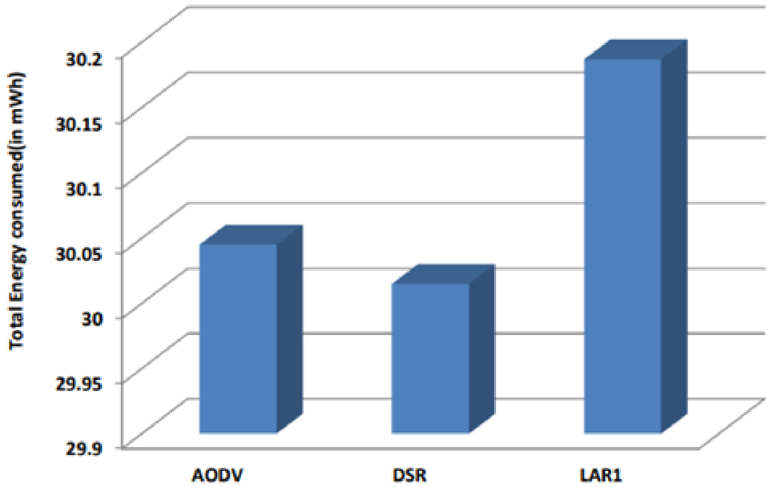

Figure 7: Version in overall power used for AODV, DSR & LAR1 at 60 Nodes

We may deduce that the LAR technique has a higher overall strength consumption from the graph above. The incorporation of strength conservation into LAR therefore lowers the electricity usage. energy conservation is vital for each node in MANETs because of the limited garage & strength ability of nodes. To further lessen power intake, power Saving LAR (PSLAR) consists of the energy Saving Mode from IEEE 802.11.

Impact of Network Size on the performance of LAR in MANETs

Experiments with different network sizes (nodes) are used to assess the LAR protocol's performance. For the sake of experimentation, the network size is classified as small (1-40), medium (41-80), or big (81-120). The number of nodes taken into account in three different network size categories: small (30), medium (60),&big (90). There is a 900-second simulation time. An area of 1000 x 1000 square meters is the terrain. The tests are conducted using the EXata simulator with the settings listed in Table 1 &the placement of nodes is random.

Table 1: Simulation parameters with varying Network size

Simulation Area	1000 x 1000 m^2
Network Size	30,60&90
Node Placement Model	Random
Mobility Model	Random waypoint
Data Rate	2Mbps
Simulation Time	900 sec
Hello Interval Time	3sec
Antenna type	Omni directional

Presented below are the subsequent output metrics that are used while evaluating the routing protocol's performance.

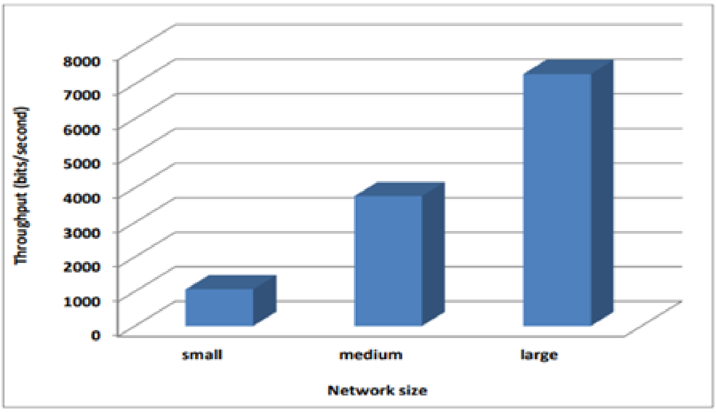

Figure 8: Variation in Throughput with number of nodes for LAR protocol.

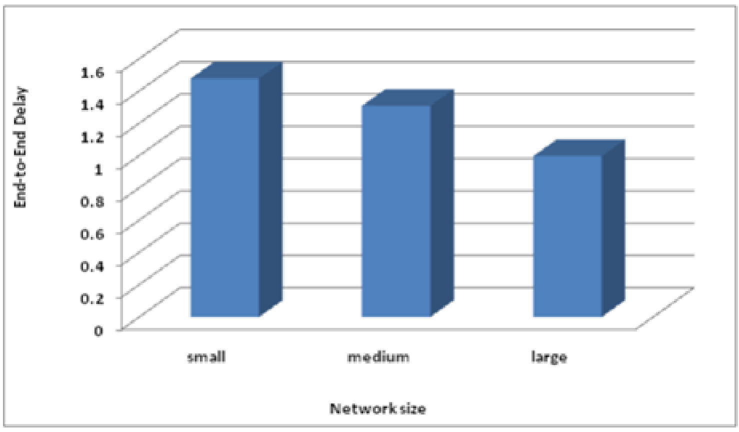

Figure 9: Variation of End-to-End Delay with Network Size for LAR protocol

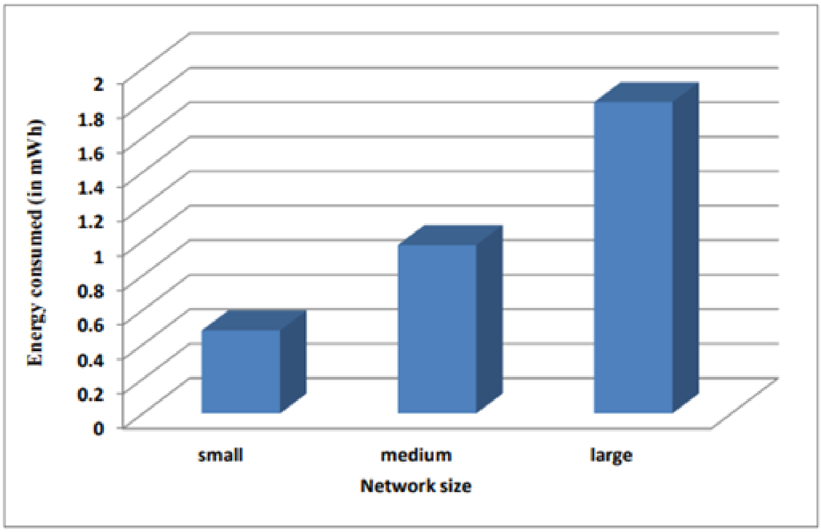

Figure 10: Energy variation Consumed in Transmit mode with number of nodes for LAR protocol.

CONCLUSION

The recommended routing protocols are implemented using the EXata simulator. The PSLAR protocol was developed by including a power-saving option into the LAR protocol. The findings demonstrate that the PSLAR protocol performs better than the conventional LAR protocol for a range of network sizes. It turns out that the primary cause of the LAR protocol's exorbitant power consumption is HIT. The HIT dynamic values are found using fuzzy logic in the FBPSLAR protocol. The results demonstrate the superior performance of FBPSLAR when comparing the two protocols across a range of network sizes. The lifespan of the network can be increased by, for example, avoiding low-energy nodes in favour of more energy-rich paths in energy-efficient routing protocols. By including techniques such as secure key management, authentication procedures, and intrusion detection systems, security concerns may be included into these protocols. This creates a secure and sustainable communication environment by ensuring that data packets are routed to use the least amount of energy while also shielding the network from damaging attacks. Trust-based approaches are becoming more popular in MANETs as a way to reduce energy usage and increase security. These models evaluate network nodes' dependability based on their historical performance, including how reliably they relay packets or respond to requests. The network can improve security by avoiding potentially attack-prone pathways by choosing reliable nodes for communication. By guaranteeing that nodes with a track record of economical energy use are given preference over those that are less dependable or more resource-hungry, trust-based systems can also help reduce energy use. Trust-based models increase security and energy efficiency, but they have the drawback of making it difficult to have correct and current trust information in a dynamic network where node activity can change quickly.

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