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Research Progress on MANET with Variation in Transmission Power using AODV Routing Protocol to Performance Evaluation

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Abstract—A Mobile Ad Hoc Network (MANET) is a decentralised wireless network that does not rely on pre-existing infrastructure. Instead, it is each node's responsibility to forward data according to its specified routing protocol. MANET is a networking paradigm that facilitates users to communicate with one another by establishing a temporary network without any form of centralised administrative infrastructure. In MANET, specialised routing protocols are needed to cope with the distinctive characteristic of MANET, which is time-varying topology due to anticipated frequent node mobility. This paper can maintain the network performance stably even in the presence of malicious nodes because it ensures reliability evaluation for nodes and the path setting between nodes and secure data transmission. The superior performance of the proposed trust-based model security routing technique was confirmed through comparative experiments for packet delivery ratio, end-to-end delay time, the number of control packets, network throughput, and average path length. Several routing protocols have been developed to overcome this problem. It is difficult to determine which protocols may perform well under several network scenarios, such as network size, topology, etc. This paper provides an overview of a wide range of existing routing protocols, focusing on their characteristics and functionality. Using this work involves the performance evaluation of a designed MANET scenario with variation in transmission power using Ad-hoc on-demand multipath distance vector routing protocol at variable node configuration. The proposed technique performance of the designed MANET scenario is evaluated using several qualitative performance metrics for optimum performance and the best possible answer using a network simulator.

Keywords: — *MANET, Packet Delivery Fraction, Normalized Routing Load, Routing Protocol, AODV, DSR, Routing Protocol.*

I. Introduction

Wireless technologies such as Bluetooth or the 802.11 standards enable mobile devices to establish a Mobile Ad-hoc Network (MANET) by connecting dynamically through the wireless medium without any centralised structure [1]. MANETs offer several advantages over traditional networks, including reduced infrastructure costs, ease of establishment and fault tolerance, as routing is performed individually by nodes using other intermediate network nodes to forward packets [2] to multi-hopping, reducing the chance of bottlenecks. However, the key MANET attraction is greater mobility compared with wired solutions. There are several issues which affect the reliability of Ad-hoc networks and limit their viability for different scenarios; lack of centralised structure within MANET requires that each node must act as a router and is responsible for performing packet routing tasks; this is done using one or more common routing protocols across the MANET [3]. Performing routine tasks requires memory and computation power. However, mobile devices feature physical size and weight limitations essential for their mobility, reducing the available memory and computational resources and limiting battery power. The mobile ad-hoc network, in which Mobile nodes set up connectivity via multi-hop wireless communication, wires vigorous and competent processes in wireless networks by incorporating routing functionality into mobile nodes. MANETs have active, sometimes rapidly changing, multi-hop topologies. MANETs function like a router to maintain network connectivity since there is no centralised infrastructure to establish communication. Sometimes these mobile nodes' connections are broken due to a lack of maintained infrastructure. Hence, the need for Routing Protocols arises. These routing protocols work at a low data rate and can dynamically adapt to changing topologies talking about the historical background. It started in the 1970s, and the interest in wireless networks has been growing with full zest and zeel. Network-wide broadcast is a vital network layer function for Adhoc networks supporting route discovery and maintenance in many Adhoc unicast and multicast routing protocols. [8]. Generally, the routing protocols of MANETs can be classified into - Table Driven proactive routing protocols and On-Demand reactive routing protocols. Author [9] elaborated on table-driven routing protocols such as OLSR and DSDV for every node that persistently maintains the complete routing information of the network. A route is readily available when a node needs to forward a packet. On the other hand, in on-demand routing protocols, for instance, DSR and AODV, mobile nodes maintain path information for the destination only when they need to contact the source node or relay packets. [9] A search packet is issued and transmitted by the source node using the flooding technique to look for the destination node. Communication among

nodes can be made and setup almost at a rapid pace, especially in emergency and disaster operations, military battlefields, and even building used for security and surveillance. [11] Designing an efficient multicasting protocol in wireless mobile Adhoc networks has been challenging due to several factors, including limited bandwidth, battery power, and frequent and unpredictable network topology changes. [10]

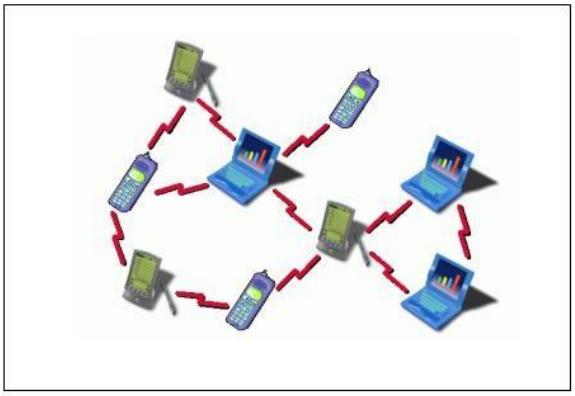

Figure 1 Mobile ad-hoc networks

1.1 MANETs routing protocols classifications
Routing protocols are broadly classified into three types, as shown in fig 2 below

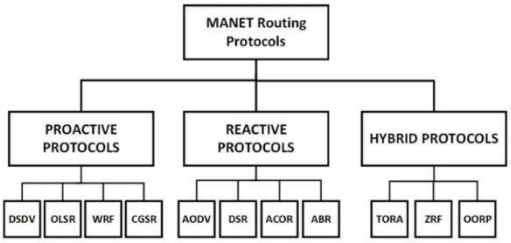

Figure 2 MANETs routing protocols classifications

1. Pro-active routing protocols:-These is also known as table-driven routing protocols. Each mobile node maintains a separate routing table which contains the information on the routes to all the possible destination mobile nodes. Since the topology in the mobile ad-hoc network is dynamic, these routing tables are updated periodically as and when the network topology changes. It has a limitation that it doesn't work well for large networks as the entries in the routing table become too large since they need to maintain the route information to all possible nodes.

2. Reactive routing protocols:-These is also known as on-demand routing protocols. In this type of routing, the route is discovered only when required/needed. The route discovery process floods the route request packets throughout the mobile network. It consists of two major phases: route discovery and route maintenance.

3. Hybrid Routing protocol:-It combines the advantages of both reactive and pro-active routing protocols. These protocols are adaptive and adapt according to the zone and position of the source and destination mobile nodes. One of the most popular hybrid routing protocols is Zone Routing Protocol (ZRP).

The whole network is divided into different zones, and the source and destination mobile node position is then observed. If the source and destination mobile nodes are present in the same zone, then proactive routing is used to transmit the data packets between them. And if the source and destination mobile nodes are present in different zones, then reactive routing is used to transmit the data packets between them.

1.2 Characteristics of MANET routing protocol
In order to avoid problems with routing in MANET, routing protocols should have the following characteristics:

1. It should be widely distributed.
2. It must be localised.
3. Because of node mobility, it should be adjustable to frequent topology changes.
4. It must be free of impermeable routes.
5. The convergence of routes must be fast.
6. Each node in the network should be required to store information about the network's stable local topology.
7. It should be able to provide high-quality service

1.3 Applications of MANET
Some distinctive MANET applications include the Military field: Ad-Hoc networking can permit the army to exploit the benefit of conventional network expertise for preserving any info network among vehicles, armed forces, and headquarters of information. Cooperative work: in order to facilitate the commercial settings, the necessity for concerted computing is very significant external to the office atmosphere and surroundings compared to the internal environment. People want outside meetings to exchange information and cooperate with each other regarding any assigned task. Confined level: Ad-Hoc networks can freely associate with immediate, in addition, momentary hypermedia networks using laptop computers for sharing the info with all the contestants, e.g., classroom and conference. Additional valid and confined level applications may be in the domestic network where these devices can interconnect straight in exchanging information. PAN and Bluetooth: A PAN is a localised and tiny range network whose devices generally belong to a specified individual. Limited-range MANET, such as Bluetooth, can make simpler the exchange among several

portable devices like a laptop and a cell phone. Business Sector: Ad-hoc network could be used for rescuing and emergency processes for adversity assistance struggles, for instance, in flood, fire or earthquake. Emergency saving procedures should occur where damaged, and non-existing transmission structures and quick preparation of a transmission network are required [10]. Sensor Networks: managing home appliances with MANETs in both cases, like nearby and distantly. Tracking of objects like creatures. Weather sensing-related activities. Backup Services: liberation operations, tragedy recovery, diagnosis or status or record handing in hospitals, replacement of stationary infrastructure. Educational sector: arrangement of communications facilities for computer-generated conference rooms or classrooms, or laboratories [5].

II. Related work

In this section, we describe various existing systems of MANETs routing protocols used to improve the MANETs routing protocols service, i.e., energy issues and security. Here those are working in the field of MANETs service improvement. Many papers try to simulate or analyse reactive and proactive protocols in general. The problem with analytical approaches is that protocols like DSR, DSDV and AODV are complex and can be configured in many ways to achieve high performance in various scenarios. In this section, we list the prior work done in protocol comparison in Adhoc environments. Das et al. [6] developed a standard AODV protocol that used the number of hops for making a routing decision. There are several variants of the AODV protocol that use other routing metrics. J. Broch et al. [7] evaluate the performance of multiple routing protocols (AODV, DSR, OLSR and DSDV) based on PDR and routing overhead. They analysed through experiments that the Temporally Ordered Routing Algorithm gives the worst performance in terms of routing overhead, and AODV outperforms DSR in terms of routing overhead. In contrast, the other performance metrics of AODV and DSR are almost the same at all mobility rates. Akshay Shankar et al. [8], Performance Comparison of AODV, DSR, DSDV and OLSR MANET Routing Protocols, 2016) analysed the performance of well-known MANETs routing protocols in high mobility cases under the low, medium and high-density scenario. They have analysed Average End-to-End Delay, Normalized Routing Load (NRL), Packet Delivery Fraction (PDF) and Throughput. Simulation results verify that AODV performs better than DSR and DSDV. Samir R. Das et al. [9] presented the performance studies between two reactive routing protocols, AODV and DSR, for ad hoc networks by changing network load, mobility, and network size. They evaluated AODV and DSR based on PDR. They observed that DSR performs better than AODV in smaller network sizes, lower load and lower mobility. In contrast, it is not true in larger network sizes, more load and higher mobility. The routing load generated by DSR is less than AODV. A. A. Chavana et al. [10] have analysed AODV and DSDV regarding routing overhead, packet delivery ratio, throughput and end-to-end delay. The performance of AODV is better than DSDV in terms of throughput, packet delivery ratio and routing overhead. Ahmed Al-Maashri et al. [11] assessed the execution of AODV, DSR and OLSR in the existence of self-similar traffic. They have considered throughput, PDR, delay, and routing overhead as QoS performance metrics. The simulation results showed that the performance of DSR is better in terms of the above-motioned QoS performance metrics at speeds less than ten m/s. Zafar M. et al. [12] analysed the comprehensive experimental performance of DSR, AODV, and DSDV routing protocol for different metrics values with predefined constraints. The different scenarios had been designed with a fixed number of nodes. Still, varying mobility Alshaer et al. [13]Extended versions of unicast AODV protocol for multipath routing are ad-hoc On-demand multipath distance vector routing, AODV-backup routing and multipath QoS aware reliable reverse path routing protocol. Multicast AODV is an extended version of the AODV protocol for multicasting. AODV protocol-based broadcasting is proposed and used in vehicular Adhoc networks (VANET). Emergency information in VANET sensed by any node must be broadcasted to all other nodes to avoid accidents. In order to avoid redundancy and broadcast storm, route requests (RREQ) packets in AODV protocol are used to determine the distance of the nodes based on which delay time is computed, and the data is broadcasted probabilistically. It is found from the literature that delay-aware, QoS-aware, topology-aware and power-aware routing protocols outperform these classical protocols. S. Gowri Shanker et al. [14] performed the analysis of OLSR and AODV by using NS-2. The simulation period for each scenario was 900 seconds, and the simulated mobility network area was 800 m x 500 m. In each simulation scenario, the nodes were initially located at the centre of the simulation region. The nodes start moving after the first 10 seconds of simulated time. The application generated is CBR traffic, and IP is used as the Network layer protocol. Dilpreet Kaur & Naresh Kumar highlighted the significant issues and challenges in ad hoc networks. This research paper describes the characteristics of ad hoc routing protocols Ad-hoc OnDemand Distance Vector Routing (AODV), Optimised link State Routing (OLSR), Temporally Ordered Routing Algorithm (TORA), Dynamic Source Routing (DSR), Destination-Sequenced Distance-Vector Routing (DSDV) based on the performance

metrics like packet delivery fraction, Average delay, Normalized Routing load, Throughput and Jitter under low mobility and low traffic network as well as under high mobility and high traffic network. A.E. Mahmoud et al. [15] studied & analysed three protocols, AODV, DSDV and IDSDV & which were simulated using NS-2 packages and were compared in terms of packet delivery ratio, end-to-end delay and routing overhead in a different environment; a varying number of nodes, speed and pause time. Simulation results show that I-DSDV compared with DSDV, reduces the number of dropped data packets with little increased overhead at higher rates of node mobility but still can't compete with AODV in higher node speed and number of the node. D. Sharma et al. [16], With the evolution of dynamically changing network applications for efficient, seamless and last-mile connectivity Mobile Ad-hoc Networks (MANETs) provide a cost-effective solution. The mobile nodes in MANETs are randomly connected, and their location and functioning keep changing based on the situation and network application requirements. However, the nodes in MANETs are battery-powered, which is one of the limiting factors in their performance. However, seamless and longer-duration connectivity depends upon the lifetime of individual nodes. Power consumption during transmission is a critical design issue in MANETs. This work involves the performance evaluation of a designed MANET scenario with variation in transmission power using Ad-hoc OnDemand Multipath Distance Vector (AOMDV) Routing Protocol (RP) at variable node configuration. The performance of the designed MANET scenario is evaluated using several qualitative performance metrics for optimum performance using the QualNet simulator.

III. Problem formulation

The highly dynamic nature of mobile ad hoc networks results in frequent and unpredictable changes in network topology. It hence makes routing among the mobile nodes a complex and difficult task. The challenges and complexities and the importance of routing protocols make the routing process the most active and innovative research area in the MANET domain. The issues in routing techniques include the large area of flooding, greedy forwarding, flat addressing and widely distributed information, large power consumption, interference and load balancing.

IV. Conclusion

As we know that mobile nodes in MANET are battery-powered; therefore, we need to increase their life by reducing energy consumption by choosing a routing protocol which is energy efficient. In this work, we will try to know which protocol is energy efficient in different scenarios. This work overviews different routing protocols: AODV, DSDV, DSR and TORA. A detailed review was done on the research done by various eminent researchers on mobile Adhoc networks. Various areas, like performance analysis based on routing protocols, routing algorithms, multicasting etc., are focused upon in research papers. An effort has been made in this review paper to filter the grey areas that could be worked upon in the future. Some areas of importance that can be focused upon include optimal bandwidth, computing power, memory and battery power, and improving quality of service (QoS). It also provides effects of various routing protocols like DSR, AODV, OLSR & their hybrid protocols. The other research paper will evaluate the performance of routing protocols such as AODV, TORA and DSR. A study is performed on various routing algorithms, including the traditional routing algorithms, namely table-driven and source-initiated routing algorithms. Thus the ad hoc routing algorithm is divided into nine categories source-initiated (reactive or on-demand), table-driven (proactive), hybrid, hierarchical multipath, multicast, location-aware, geographical multicast) power-aware. Even though each protocol class has a different operational mechanism, they all come under one roof with the common aim to minimise packet overhead, maximise throughput and minimise the end-end delay. In this survey, the major routing issues faced by the routing protocols are discussed, and an effective study of the various categories of routing algorithms, along with a comparative study, is performed. The proposed technique performance of the designed MANET scenario is evaluated using several qualitative performance metrics for optimum performance and the best possible answer using a network simulator.

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