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Strategy to Minimize Routing Configuration Overhead: AODV Algorithm for AD HOC wireless Network (MANETs)

Ashutosh Kumar Sharma[1*], Dr Mukesh Kumar[2]

[1] Research Scholar, Sunrise University, Alwar, Rajasthan

[2] Assistant Professor, Dept. of Computer Science, Sunrise University, Alwar, Rajasthan

Abstract - A Mobile Ad-Hoc Network (MANET) is a group of wireless nodes that establish a temporary network without the use of a centralised access point, infrastructure, or management. Because of their dynamic topology and decentralised administration, MANETs are attracting a lot of attention. Different areas of research can be considered, such as routing, synchronisation, power usage, bandwidth issues, and so on.The major goal of this work is to investigate concerns with the AODV protocol's route finding process for MANETs. Route establishment is complicated by a flood of route request messages. This study proposes a new method for reducing routing overhead in route finding. The new protocol avoids undesired queries during in the route formation process by taking into account the network's historical performance.

Keywords - Flooding , Wireless Network, MANET, AODV

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INTRODUCTION

A self-organizing, multi-hop, wireless network is known as a mobile ad hoc network. This type of networking is simple to set up because it does not require much space or time, and it can be done without any facilities. It has been commonly used in a number of settings, including dangerous areas, military regions, hospitals, and family gatherings. Ad hoc networks have their own routing algorithm given the dynamic changes in topology. The IETF's MANET working group recommends the AODV routing protocol over other ad hoc routing protocols because of its higher authority and simple but functional success. However, because the AODV routing protocol does not consider the current load of nodes during routing protocol, it may cause localised congestion issues.MANET's main application domain is data propagation. In those applications, reliable packet switching is critical and important. The infinite mobility and more frequent malfunctions due to link breaking are two major challenges in MANET communication. As a result, traditional routing methods are grossly inadequate for ad-hoc networks. Some many scholars have applied performance metrics to conduct qualitative and quantitative analyses of ad hoc routing protocols [5,6,8]. The routing protocols have been divided into two categories by the scientific community [2]. There are two types of routing protocols: proactive (table-driven) and reactive (on-demand).In this particular instance, each node establishes a routing table that contains information about the routes to all other nodes in the network and is updated on a regular basis. Each node has access to the most up-to-date data at all times, regardless of the necessity. The periodic propagation of route discovery, on the other hand, tends to increase network overhead. On the other side, a reactive protocol only finds the route when it is requested. In terms of throughput, PDR, and routing overhead, results have demonstrated that reactive protocol outer outperforms proactive protocol [6, 8]. As a result, the study has primarily focused on reactive protocols.

Developments to the AODV have been a key area of research [12,18]. The main goal of this research is to take advantage of AODV's defined as the characteristic. The route discovery process is initiated by the source node trying to send a request packet control packet. The article also emphasises the importance of network overhead during the route discovery phase and attempts to propose a solution for lowering it. The suggested methodology ensures that the network is flooded with the smallest number of route request messages possible.

The remaining article is organised in the following manner. The route discovery process is described in Section 2 using AODV. The flooding of route request messages in the network is discussed in Section 3. In section 4, relevant literatures are discussed. In section 5, a new approach to reducing flooding overhead is mentioned, and in section 6, a conclusion is given.

ESTABLISHMENT OF ROUTES IN AODV

Request-response cycles are used by AODV nodes to discover routes. By broadcasting an RREQ message to all of its neighbours, a node requests a route to the destination. When a node that receives an RREQ message but does not have a route to the proper destinations, it telecasts the message to the people of the network.Because AODV is a reactive (or on-demand) MANET routing protocol, it only keeps paths in the system that have a requirement. AODV keeps a routing table with the next hop for trying to reach destinations. If no data packet are sent out on path for a long time, it will time out. Because it only contains data about its neighbours, re-transferring the data packets may take longer.

There are three different types of routing messages.

RREQ stands for Route Request

When a node wants to send or send a packet but doesn't know how, it has sent an RREQ multicast msg to begin the route discovery. Before it arrives at its destination node, neighbouring nodes keep track of where the text originally came and forward it to their neighbours.

RREP stands for Route Reply

The destination node needs to respond with an RREP, which follows the RREQ's path directly to the origin. Forward routes are founded in the relay node as the RREP comes back to the source. In response to a received RREQ, if a node in the network knows the route to the destination, it may just sent an RREP, enabling nodes to join a defined route. Once the RREP reaches at the source and the route is formed, interaction between the source and the destination will start.

In contrast to proactive routing protocol, responsive routing protocol excludes routing overhead during regular intervals exchange of information. The up-to-date routing table is not retained in reactive or on-demand protocols. It will only explore the route once it has data to transmit. As a result, the routing overhead is reduced. The first step in a reactive protocol's data dissemination is to determine the route. This lengthens the time it would take to set up the course. To gain the benefits of both table-driven and on-demand routing protocols, a hybrid protocol can be created by combining the two methods. Over the decades, various methodologies have been proposed under these categories. [14].While on-demand routing protocols such as AODV, DSR, and TORA exist, ZRP is a hybrid protocol. The AODV algorithm is investigated in this paper, as well as the overhead during in the route establishment phase. A large number of studies have been published in order to reduce the network's unwanted load [3, 4]. The goal of this paper is to investigate AODV in the context of multiple connections and the overhead needed to establish them via reroute discovery. The goal of the proposed plan is to develop the AODV by lowering the route discovery overhead.

The route discovery phase and the route system testing are the two important different stages in the AODV implementation [1]. We are only interested in the route discovery process in this paper. To begin, a source node that wants to set up a route floods the network with the route request message RREQ. In order to avoid plagiarism, each RREQ packet is assigned an identifier. Only a receiving node will accept a packet with the new identifier. When an RREQ packet arrives with the same sequence number, it is thrown away. If a node knows something about the location, it responds to the origin.If no response is received from any node after a set period of time, it attempts to reconnect the route by sending an RREQ packet. When a server receives an RREQ packet, it records information about its neighbour so that an opposite path can be established. When the RREQ packet arrives at its destination, it sends a reverse path reply message RREP to the sender. Following that, the source creates a forward route to the destination. Route request packet RREQ transmission comes to a halt at the destination. The route reply packet RREP is generated by the destination node and sent to the source node in the opposite direction of the discovered path.

Route Error – REER

As a reactive protocol, AODV typically has less overhead than proactive protocols. A RERR message is sent with a node that detects the link disruptions if the connection is lost and the path no longer functions, i.e. messages cannot be sent. Other nodes will recast the message. The RERR message displays the unreachable location. The route is deactivated when message having received nodes receive messages.

If any link failures are discovered during data transmission, the node that is experiencing the problem notifies its neighbours. This message spreads throughout the network until it reaches the source node. In this particular instance, the route creation process is restarted from the beginning. Between two nodes, a link failure can be detected using the HELLO packet. The absence of a HELLO packet suggests that the neighbour has relocated. Because the nodes in MANET are so mobile, link breakage and establishment are common. Each route is affiliated with a timer in order to deal with this issue. After a certain amount of time, the existing route is removed and the route establishment process repeats in order to establish a good course.

OVERHEAD DURING ROUTE DISCOVERY PROCESS

Communication between two nodes is separated into 2 phases by AODV. The route discovery phase, wherein the source node works with other nodes to find a route to the destination, and the packet forward process, in which nodes work together to forward packets between sender and receiver along the designed route.The reduction of overhead due to frequent routing table interaction is one advantage of AODV over other proactive routing protocols like DSDV. Because of its on-demand capabilities, AODV reduces this overhead. The route incorporation procedure is done out whenever data needs to be sent. There would be no exchange of information between neighbours if this were not the case. The process of route discovery begins at the source node and ends at the destination node. Because of the constantly changing topology of AODV, flooding is the best strategy for route discovery. Flooding generates a large number of texts even if the routing overhead is lowered.

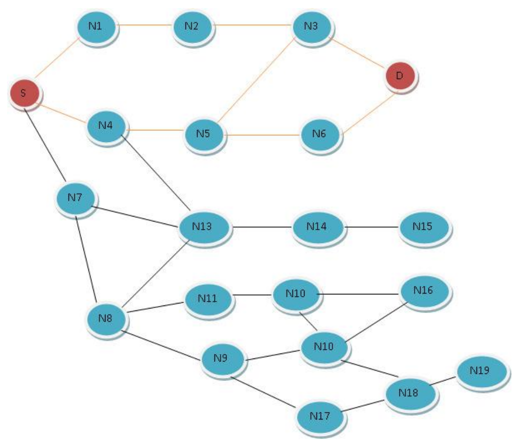

Fig.1: A typical network showing the flooding overhead; though there are only three pathsfrom S to D, the flooding is wide spread.

During the route discovery phase, the source node generates and sends the RREQ route request control message to its neighbours.Every moment a node wants to find the location, it sends the same message across the network. Although some of the nodes simply flood the msg, they frequently fail to reach the intended destination. This creates a significant challenging problem for AODV route discovery. Because of these ineffective and superfluous messages, useful and restricted resources such as node energy, bandwidth, and battery power are squandered. With larger networks, the issue becomes more significant.

REVIEW OF RELATED WORK

Although mobile ad hoc networks are a key area of study, they often increase the network's cost. The AODV protocol has been the subject of a lot of research for its ability to reduce routing overhead [3, 4, 18, 25]. Many of them are more concerned with routing efficiency than with route discovery.

Many strategies to reducing the redundancy of route request packets have been proposed in the past. To minimise flooding overhead, several strategies where each node transmits route request packets with some probability were suggested, and several route discovery protocols . Furthermore, many strategies provide their own unique remedies.

Aminu Mohammed et al. proposed a new probability - based counter-based program that uses counter-based and gossip-based characteristics. During routing protocol, the suggested technique can greatly reduce the amount of RREQ messages delivered. In a similar manner, the authors of [5] proposed a theoretical flooding method that adapts the forwarding probability at a node based on its local topological characteristics. Unlike the previous two, Li Jian et al. proposed a Positional Attribute based Next-hop Determination Strategy and identified the "next-hop racing" phenomenon caused by the random livecast delay strategy used during route discovery. Wireless broadcast storm can be effectively avoided using the proposed method.There are a range of methods available, each with its own set of solutions. Bani Khalaf M. et al.[10] suggested a new distributed route discovery system to efficiently handle broadcast operations by minimizing the number of broadcast deduplication request packets and collisions and assertions. Lukas Wallentin et al. proposed a new cross-layer optimised route discovery scheme based on a distributed route pre-selection method and artificial route discovery packet delaying in [11]. Natarajan Meghanathan and colleagues present a new network density and movement aware power broadcast route discovery strategic plan for determining specific pattern in MANETs in [12].

During first approach, the node in the network will react only if it has information about the target when it receives an RREQ packet. As a result, the message flooding will come to a halt at the intermediate node. This method, however, does not guarantee the best route. The second approach restricts the scope of the route discovery effort. The search scope is risen by some component with each attempt. The RREQ message is flooded after a scope-only highest threshold is reached.

The rise in routing latency is a disadvantage of this approach. When route discovery fails or a path breaks, a new path discovery loop is started.

The following are among the current systems for avoiding duplicate message flooding :

Probability[1] – Each node broadcasts the msg it receives for the first moment with a certain probability. P.

Counter-based [1] - Each node only broadcasts the msg if it hasn't seen it more than c times before. If a text has been conveyed some many times, the network will experience additional overhead.

Distance-based [1] - Each node only telecasts the msg if the physical distance among them is less than a certain value d. The signal power can be used to calculate spacing.

Keeping malicious flooding at bay [3] - Extreme flooding caused by malicious nodes in a network is one of the most common problems in ad hoc networks. By restricting hyper activism, the flooding of packets into the network by malicious nodes who do not abide any limits is lowered in the strategy reported in [3]. Each receiving node has a limit on how much RREQ it can obtain. When an RREQ request reaches a node, the RREQ RATELIMIT is checked first. If the capacity is reached, all requests produced by the sending node, which is presumed of being malevolent, are blocked for the showed that life.

SUGGESTED STRATEGY FOR MINIMIZING THE FLOODING OF ROUTE REQUESTS

Flooding of route requests is a key problem in the AODV route request phase. The location may be unavailable or the request may have been lost due to transmission errors. In these situations, source re-starts the route discovery. Despite the fact that routing overhead is lower than proactive protocols, route discovery overhead wastes the network's scarce resources. The main goal of this article is to suggest a simple process for route search in AODV that has less overhead and lower trying to search latency. The proposed solution is also simple in terms of communication and computation.This analysis takes into consideration the likelihood of connecting to the desired location. The probability is determined by a node's earlier actions in obtaining the location via an outgoing link. The possibility of choosing the neighbour to introduce a route request is calculated using the connectivity index (k).

$$\mu_k = \frac{\text{Number of Success Obtained}}{\text{Number of Attempts Made}} = \frac{S_{1.....k}}{A_{1.....k}}$$

Evey node updates the μ_k for each outgoing link for each effort employing

$$\mu_k \leftarrow \mu_k \alpha + (1 - \alpha)\,\mu_{k-1}$$

where α is a constant, $0<\alpha<1$.

There are numerous routes from source S to destination D shown in Fig. 1. S,N1,N2,N3,D>, S,N4,N5,N6,D>, and S,N4,N5,N3,D> are the routes that have been recognised. At first, s generates and sends the request packet to its neighbours. There is no background of the destination node on the intermediate node. The packet is then sent to its neighbours once more. This process will continue until the destination is reached. Each node floods the request packet to its neighbours during in the route search phase. Even if some of the nodes never arrive at their destination, they contribute to the message flooding. Figure 1 shows that node 17 receives the control information from node S, while node 13 receives the message from node 4.

However, that node is unable to locate the destination. As a result, those nodes are undesirable in the route-finding process. Each node maintains connectivity to avoid this undesired searching.table of indexes Tables 1.1, 1.2, and 1.3 show a sample connectivity index table for three nodes. Node 7 does not forward route request messages to its neighbours N13 and N8 in the 11th iteration. This way, we can prevent route request texts from being routed in an unwanted way. If a new link is established after a period of time, the neighbouring nodes are notified. When a route to a location is created, the intermediate nodes in the path's working seamlessly of neighbouring nodes is slightly increased.

Table 1: Connectivity Index table of node S after 10 iterations

Neighboring Node	μ_k
1	1
3	6
7	0

Table 2: Connectivity Index table of node after 10 iterations

Neighboring Node	μ_k
13	0
8	0

Table 3: connectivity index table node 4 after 10 iterations

Neighboring Node	μ_k
5	7
13	0

FINAL RESULTS

Flooding is a simple mechanism of route searching in an on-demand routing algorithm, but it waste products system resources, causes traffic jams, assertion, and bandwidth overhead. The new method is intended to reduce flooding overhead to a certain extent. Each node in the new approach sends the message to its neighbor nodes based on the likelihood of sensing the endpoint. The above-mentioned improved performance in the AODV algorithm is constantly improving the performance of the link startup process. In terms of bandwidth, battery power, and node energy, this will significantly improve achievement. This presents a means with a lower complexity and the ability to communicate.In communication, routing and protocols such as Manets AODV Reactive Routing Protocol are essential. We were able to learn about the overview section and how it works, as well as the three different types of packet forwarding. You now know enough about the Manets AODV Reactive Routing Protocol to understand it.

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Corresponding Author

Ashutosh Kumar Sharma*

Research Scholar, Sunrise University, Alwar, Rajasthan