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MEDIUM ACCESS CONTROL BASED BUSY TONE ROUTING IN MANET

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Abstract

Several MANET designs looked into renewable resource efficient protocols. The amount of energy dissipated by MANET nodes is an important coordinating component. In monitoring applications, power usage is ensured, and battery depletions are reduced to avoid frequent replacement. MANET's primary goal is to relay data by utilising energy-efficient routing techniques and extending the network's lifespan. In this research, we provide an Energy Efficient Protocol on Remaining Energy, a new paradigm for MANET multicasting. Our idea is based on a tone system that integrates solutions across the Medium Access Control (MAC) layer to deliver more efficiency and better performance. To provide increased stability and lower energy consumption, the protocol includes a new construction mechanism for mobile nodes that uses a clustering strategy based on distance and remaining energy. We also propose modifying the conventional multicast flow by introducing unicast links between clusters. In addition, we describe a strategy based on a busy tone system to eliminate excessive control overhead produced by control packets in error recovery in our model. The simulation results are displayed in NS2, and they indicate improvements in reliability, packet delivery ratio, energy usage, and throughput.

Keywords:

Energy Efficiency, MANETs, Mobility, Routing

1. INTRODUCTION

Most organisations and businesses nowadays make their services available on the Internet so that they can be accessed by a wide range of people. When numerous users request a service, however, it is preferable to employ multicast transmission to save time and effort. By utilising the broadcast characteristic of wireless transmission, a multicast can be utilised to increase network efficiency by delivering multiple copies rather than one copy at a time; this may lower the communications cost of applications that employ multicast rather than unicast.

Many current applications demand a dependable multicast method, which means that one sender must secure data delivery to several receivers; this can be difficult to do, especially in a wireless setting. Although packet loss occurs more commonly in wireless contexts than in wired environments, such losses occur in both. We can lower the bandwidth consumption of networks and the time it takes to use them by using multicast transmission.

A mobile ad hoc network is made up of moving mobile nodes that establish a temporary network without the use of any centralised infrastructure such as access points or base stations. The phrase ad hoc comes from Latin and means for this purpose, which in this context denotes that the network exists for a specific reason and can be dissolved quickly (on-the-spot) [1].

All moving nodes in MANETs coordinate with one another to facilitate communication and manage routing and resources in a dispersed way. This means that each MANET node must be more sophisticated in order to function as a sender for sending messages, a receiver for receiving data from another master sender who received the initial message, and a router for routing packets to other nodes [2].

MANETs are extremely dynamic and distributed, with nodes that are largely battery powered and have a limited power supply. As a result, energy consumption is a major issue in MANETs, with node failures occasionally affecting the entire network. If one node loses power, the likelihood of network separation increases. Thus, to extend the MANET's lifetime, we must consider energy-efficient ways to reduce network energy consumption, such as announcing a remaining energy, which will prevent energy depletion and reduce the network separation [1].

2. LITERATURE SURVEY

Stationary mode wireless sensor networks are the most frequent on the basis of their initial design concepts. The growing popularity of mobility features opens the door to a new MANET implementation.

A state-of-the-art mobility management in MANETs was investigated in [6]. The mobility function may cause serious disagreements in the protocol architecture at the connection layer. Location minimises those level challenges and helps to estimate the network's connection quality with the use of mobility-enabled protocols.

The proposed protocol for Hybrid Channel Reservations and Busy Tone in [7] is a solution to the problem of secret and exposed terminals. This well adapts in real time to broadcast systems that use channel reservations and dual tonalities. In most cases, channel reservation information is sent in the form of connected packets. The technique, on the other hand, suggested employing a busy tone to solve hidden and revealed terminal difficulties as well as convey channel reservation information. The research revealed that the suggested methods are more stable when choosing a channel. As a result of the occurrence of secret terminals and exposed terminal issues, the reception of Channel Booking information has substantially improved.

The lack of infrastructure in MAC networks, secret terminal problems, obvious terminal problems, and complex topology were all examined in [8]. The activities of two MAC protocols, wireless and DBTMA multiple-access collision avoidance, are investigated. The bandwidth use QoS assessment is taken into account. The results show a variety of network topologies that are suitable for the MAC protocol, as well as MAC protocol design that is stable and efficient.

This section provides a comprehensive description of energy-efficient routing strategies, load balancing techniques, and mobility foreclosure-based routing procedures. These tactics have also been clarified, as well as the merits and drawbacks of these strategies. MANET uses the most up-to-date methods in a stationary mode that operates entirely according to its own design criteria, ensuring that accessibility features are put to the best possible use on the road. This improves mobility efficiency by increasing node density, but it has a number of drawbacks, including localization mistakes, reduced coverage, increased latency, limited acceptance in real-time settings, and increased time utilisation.

The installation of sensor networks, which are a subset of ad hoc wireless networks, has numerous challenges. No infrastructure is required for wireless sensor nodes to communicate loss lines. Another stumbling block is the minimal number of sensor nodes available, which rely on non-renewable resources. Let's take a closer look at the pertinent design issues. Sensor nodes are inherently unstable and are typically utilised in dangerous settings. Nodes can fail due to physical damage, hardware difficulties, or a lack of energy. We anticipate that node failures will be significantly higher than in wired or wireless networks. Sensor networks have tens of thousands to hundreds of thousands of nodes. Furthermore, the density of consumption varies. To gather high resolution information within its broadcasting radius, the node density will exceed a node with over several thousand neighbours. Sensor networks can only deal with traditional data gathering methods if single sensor nodes are manufactured relatively cheaply, as many implementing models consider sensor nodes to be disposable instruments. MANET has progressed in many ways, but it still has limitations in terms of energy, computer processing power, memory, and communication networks. Communication between nodes is usually done via the common ISM bands. Some sensor systems, on the other hand, use infrared connectivity, which is steady and practically interference-free.

3. PROPOSED MODEL

For MANET multicasting, we suggest a hierarchical tree-based design with a specific type of predetermined clustering technique. We discovered that most routing techniques do not rely on node power preservation, which is crucial for providing reliable multicast, which is our goal, from the literature on routing protocols. We offer the Reliable and Energy Efficient protocol Depending on Distance and Remaining Energy, a new reactive technique that is based on the distance and remaining energy of nodes in a mobile ad hoc network.

The following stages make up the model.

Step 1: The route request and route replay mechanisms are defined in the first stage.

Step 2: In the second stage, we construct a multicast tree using a clustering approach, starting with the master sender (MS), which is the node that sends the original message to the involved members, and dividing these nodes into three clusters based on two calculated distance thresholds: cluster By calculating the remaining energy in all nodes in all clusters in our tree design, we suggest an effective approach to preserving resources in the third stage.

Step 3: In the final stage, we propose adjusting the multicast flow so that each cluster receives the message in a sequential sequence according to our structure.

Routes are created using on-demand approaches. The request route (RREQ) packet is used for route discovery in our protocol and other reactive protocols, while the route reply (RREP) packet is used for traditional AODV protocol. We suggest a change to the request-reply packet operations in our protocol. To make our approach more efficient in terms of saving network resources, we apply tones to these requests and reply packets that will be sent before the RREQ and RREP packets. We'll include predetermined tones for the request and reply mechanisms because our model supports short plus tones.

The relative tones for RREQ are known as route request tones (RRQT), while the relative tones for RREP are known as route reply tone (RRPT). By using these tones, the system will be able to prevent control overhead and packet collisions, as well as reduce the impact of black hole assaults in reactive protocols. All route requests in our protocol will be transmitted from the node that contains the initial message, known as the master sender (MS), and gathered from other mobile nodes and forwarded to this node.

To search for a destination, the MS in our protocol will broadcast two route request tones (RRQT) with a present time (i.e., 20 microseconds each) prior to the request packet. Prior to the reply packets, if the destination is reached, it will respond with two route reply tones (RRPT) of a predetermined duration (i.e., 25 microseconds each). Only if the tones are successfully received will request and reply packets be transmitted. This will provide some level of assurance and prevent reply packets from clashing.

To use tones in our approach, the duration and spacing between tones must be consistent and predetermined. Fortunately, there are a number of standards that provide collision avoidance mechanisms, such as IEEE 802.11 WLAN's spacing frames. We'll use them in our model, but with a few tweaks to make it work for MANET. We will employ a conventional frame space and a backoff technique with a distributed coordination function (DCF) using interframe space (DIFS) that includes short interframe space (SIFS) in our model.

The following are the methods for route discovery in our model: First, for the RREQ technique, RREQ consists of two spaced RRQT delivered before the RREQ packet. Each RRQT is bounded by two SIFS. Second, if the destination is reached and the RRQT is received, the RREP method will respond with a two-spaced RRPT bounded by two SIFS and then an RREP packet. To distinguish between the route request tone and the route reply tone, we will utilise different durations. This will prevent the system from failing.

The MS will save the routes to this destination in the routing table, together with the intermediary nodes that make the route to this destination legitimate. If additional routes must be established, the process will be repeated. This will add some latency to the operation, but only successful received tones will cause the destination to respond with a packet, reducing network waste by employing short tones with brief pulses that do not cost the network. The nodes in a MANET are free to move around without any restrictions. When mobile nodes change their location announced in the network, they should send an updating message to keep track of all other mobile nodes. A new routing discovery technique should be designed to update the routing tables for the new locations and intermediate nodes if the number of update messages is considerable. If no update message is received, we assume that all routes remain in the same location, and that other messages sent by various master senders should use the same routes discovered. This will cut down on the amount of time it takes to use route discovery algorithms.

3.1 CLUSTERS CONSTRUCTION

Depending on the distance between the MS and the receiving node, we establish three hierarchical clusters in our protocol. We presume that all nodes are equipped with devices that calculate the position of concerned nodes in our approach (e.g., GPS). A GPS device is used to measure the geographical positions of all nodes on a regular basis, and these nodes will broadcast their locations. To reduce the overhead given by these update messages, update messages will only be issued if the nodes relocate to a new position.

We can determine the two farthest nodes reached in the entire network based on the information provided by the GPS device. From there, we may partition our network into two clusters using two distance thresholds. The two distance thresholds established based on the transmission of a message from the MS to the two farthest nodes in the network divide our network into three tiers.

After the distance requirements have been established and the members of each cluster have been identified. To tell these nodes of their locations and to be a part of a multicast tree occurring in each cluster, mobile nodes should send membership messages to the MS or the relative cluster head.

Because it will begin multicasting the message, the cluster that includes the node with the MS is referred to as the home region cluster. The master sender, who has the original message, gateway nodes, who will transfer the message to other clusters, and relay nodes, who will remulticast the message into their own clusters, are the three types of cluster members. This will be covered in further depth in the following section.

We can assure that all clusters will have at least one member and that nonoverlapping clusters will form by dividing the nodes into two distance thresholds, but we cannot guarantee that the distribution in all clusters will be even.

In transmission, the consumed power is calculated as

$$T_{ct} = T_e \times T \tag{1}$$

where

T_e - needed energy for transmission

T - time needed for this transmission.

In reception, the consumed power is calculated as

$$T_{cr} = R_e \times T \tag{1}$$

where

R_e - needed energy for reception

T - time needed for this reception.

The residual energy is estimated in terms of available energy and consumed energy

$$R_e = E_A - E_C$$

Stability is critical in mobile ad hoc networks. To improve MANET stability, each node in the network should be power aware, which means that each node must calculate and announce its remaining energy on a regular basis, with the help of the physical layer in all nodes in the network. All mobile nodes should use the following formulae to broadcast the remaining energy of nodes.

Thus, the remaining energy of a node may be easily estimated as [1] using Eq.(1) and Eq.(2). After calculating the remaining energy, all nodes should broadcast these numbers throughout the network to assist the MS in forming a general notion about the network's energy level for future actions.

The role of each node is classified when all nodes have announced their remaining energy and positions. Thus, the MS node will be defined in the home region cluster, following which nodes will be sorted based on their distance from the distance thresholds. We choose the node that is closest to the distance threshold to act as a gateway node, forwarding messages from one cluster to the others.

We sort the nodes in the other clusters based on their remaining energy, and we choose the cluster heads and relay nodes with the most remaining energy to be the cluster heads and relay nodes for further retransmission in their cluster.

To conserve energy in the network, nodes can function in a variety of modes; for example, in addition to transmission and reception, we can use the listen and sleep modes, which improve network stability. Transmission mode denotes whether the node is the MS or a node that sends unicast messages to other nodes. The node is in reception mode if it is a recipient of either a multicast or unicast transmission. The node is ready to receive, which implies it has enough energy, but it is not included in the multicast message, and other nodes want to send to it. Sleep mode indicates that the node is low on energy and will remain in this state until its battery is recharged. In some circumstances, nodes in sleep mode may be engaged in a multicast message; in this scenario, this node may ask the nearby node to unicast the message to it after charging the battery. In our tree-based design, we need to know which node in each cluster has the most remaining energy.

3.2 TRAFFIC FLOW ADJUSTMENT

In this step, we'll change the multicast network's normal flow to incorporate MANET and clustering properties. Once the MS has picked up nodes in the multicast tree, all nodes should be able to send an acceptance tone with a predetermined duration (i.e., 35 microseconds) to signal the sender that they are a member of the multicast group. We expect that all nodes will be able to buffer the message and retransmit it if necessary.

The MS will pick up all desired nodes and routes will be discovered in all three clusters by sending a send synchronisation packet (SSP) to the nodes and expecting an acknowledgment acceptance tone (AT) from the nodes with enough energy after we divide the network into three clusters based on

To save energy, the MS will multicast the message to nodes in cluster 1 (the home area cluster), and this will be multicast group 1. We assume that only the master sender and the gateway node will save the message in their buffers for retransmission if necessary, and that all other nodes will not save the message. This will reduce capacity overhead, resulting in improved congestion status for certain nodes.

Then, in Cluster 2, we determine which node has the most remaining energy, and that node declares itself the cluster head in Cluster 2. The closest node from cluster 1 (home region cluster gateway node) will retransmit the message by unicasting it to the node in cluster 2 with the most remaining energy; this node (the relay node or cluster head node) will then remulticast the MS message in This is multicast group 2, and the message will be saved in the buffers of just the relay and gateway nodes in this cluster.

The cluster head in cluster 3 will be the node with the most remaining energy, and the closest node from cluster 2 (the gateway node of cluster 2) will retransmit the message by unicasting the MS message to this node. This node (relay node or cluster head node) with the most remaining energy in cluster 3 will remulticast the message in cluster 3, which will be called multicast group 3. Because no gateway node is required in this cluster, only the relay node will save the master sender's message in its buffer. This conserves the MS's energy while also attempting to optimise the network's total energy consumption.

Because this is a vital operation for moving our message from one partition to another, the unicast links between the gateway nodes and the relay nodes must have a high level of dependability and error detection and correction procedures.

Our approach may cause some delays during initialization, but it overall provides an efficient means of managing energy consumption. Because we employ some type of acknowledgment of reception, which is required in a reliable scheme of multicast transmissions, nodes whose energy has run out will not cause a message to remain in one cluster and not proceed to the next partition, causing an infinite cycle in our network.

After this change, the multicast batch cluster construction is complete. Only one master sender is located in the home region cluster; two gateway nodes are positioned in the home region and cluster 2; and two relay nodes or cluster head nodes are placed in cluster 2 and cluster 3 and will remulticast the original message. Because only a few roles of nodes are required to provide multicast in the network, this structure will reduce formation overhead and cluster creation complexity.

3.3 BUSY TONES

This approach is similar to the one recommended in IEEE 802.11 [3], but we've tweaked it to make it more suitable for MANETs. Multicast transmission, as opposed to unicast broadcast to each recipient, is highly useful when there are numerous receivers. It can help save time, eliminate retransmission redundancy, and maintain network bandwidth. Unfortunately, multicast transmission does not support packet exchange reliability since no control packets, such as the three-way handshake transmit, receive, and acknowledgement, which are utilised in unicast transmissions, are employed.

To provide dependable multicast broadcasts, several techniques have been proposed. They are inefficient for MANETs, however, due to the architecture of the MANET network or the excessive use of control packets in error recovery, which can result in an intolerable overhead. In our model, we offer a simple and effective strategy called reliable multicast based on busy tone for MANET. To reduce the number of retransmissions and improve data reliability in the multicast environment, we integrate two well-known methods for error detection or recovery over the MAC layer, the Automatic Repeat Request and Forward Error Correction, with tone-based acknowledgments.

Because the RMBTM can allow block transmission, which divides the data stream into many blocks, it may be able to provide multimedia transmission. All mobile nodes in our RMBTM model are equipped with a tone-based technology that replaces control packets with short energy pulses, increasing MANET efficiency by eliminating the wasteful use of control packets.

To achieve optimum performance in the model, these tones are grouped by distinct time lengths. In the handshake process, tones are utilised instead of acknowledgment. The feedback request tone, which is delivered from the MS to all associated multicast nodes to check whether the received data is right or not, is the first sort of tone we will employ in our model. The duration of feedback request tones is fixed. Packet request tones from the receiver to the MS are the other types of tones employed in our model, and the tone number of a packet request is determined by the number of packets that must be recovered.

4. RESULTS AND DISCUSSION

The output measures are effectively analysed in this research using current and suggested approaches. The current system is less efficient, while the proposed system is more efficient. The resulting measurements are packet distribution ratio, end-to-end latency, throughput and networking lifespan assessed using current model, past work on QoS-aware Channel load-based Mobility Adaptive Routing Protocol (QoS-CLMARP). We may deduce from the findings that the device efficiency was higher than the current one by evaluating the proposed enhanced GA routing.

The time it takes to transfer a packet from source to destination through a network is called the end-to-end delay, and the table below depicts the effects of three different scenarios on the end-to-end delay.

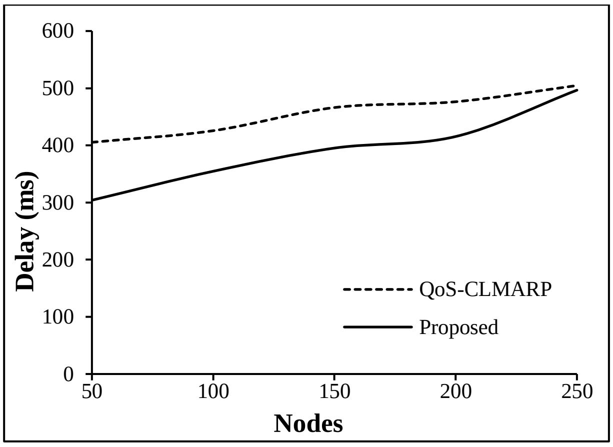

Fig.2. Results of End-to-End Delay

The difference in end-to-end delay between the proposed model and the QoS-CLMARP is shown in Fig.2. The proposed technique has a longer end-to-end latency. The routing approach significantly reduces the delay charges in the proposed scheme. As a result, the application of the suggested strategy to acquire good identification is demonstrated. As a result, the intended approach has a higher quality.

The lifetime of a network is defined as the time it takes for the first SN or node in the network to be consumed by power. The remainder of the network energy can be regarded as determining the overall network lifetime.

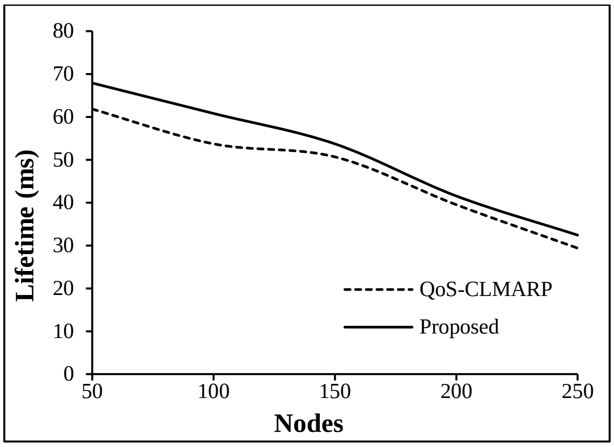

Fig.3. Results of Network Lifetime

The actual and predicted network lifetimes of the metric systems are shown in Fig.3. With the QoS-CLMARP solution, as well as the preceding functionality, network life is less important in present scenarios. The network coverage is greatly increased by applying the routing strategy to the proposed scheme. As a result, the proposed solution implies that precise detection will be obtained.

The packet delivery ratio is defined as the number of packets received successfully by the destination. The Fig.4 shows the impact of the packet delivery ratio.

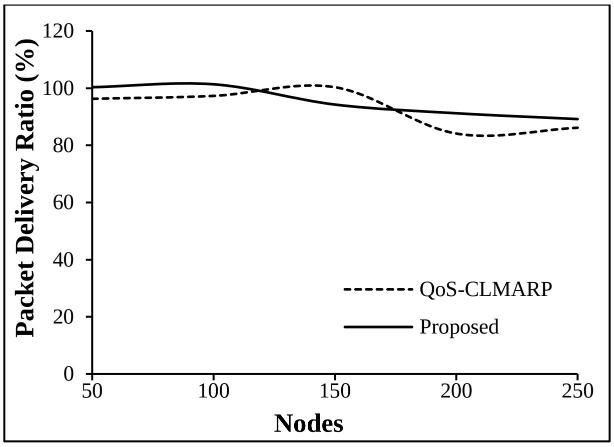

Fig.4. Packet Delivery Ratio

The packet delivery ratio is shown in Fig.4. In the current context, the proposed model is lower than in QoS-CLMARP. The proposed framework's recommended routing approach considerably improves the packet delivery ratio efficiency. This implies that the recommended method is being used to identify effectively. As a result, the proposed system performs better.

The packet loss ratio is the percentage of packets lost during transmission, and the following table shows the product of the packet loss ratio.

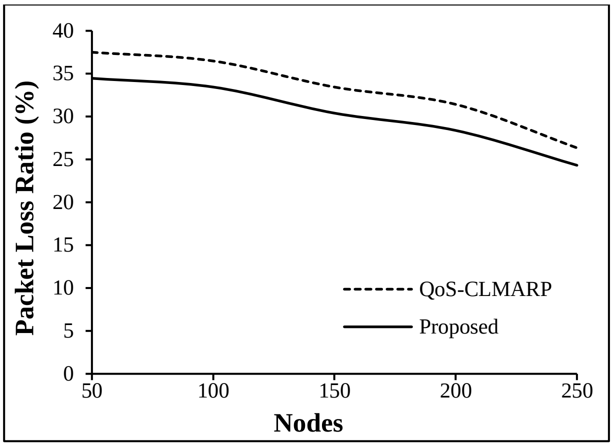

Fig.5. Results of Packet Loss Ratio

The Fig.5 demonstrates that the suggested route is more consistent in terms of efficiency and packet loss than two other options. As a result, the suggested proposed route is clearly superior in terms of lesser packet losses and better results.

5. SUMMARY

In this study, we present the tone-based model as a way to overcome the drawbacks of large energy consumption due to distance, as well as to provide congestion control and dependability in multicast transmissions over mobile ad hoc networks (MANETs). Our model is based on a tree structure, with each node separated into three partitions. Because of the energy consumption arising from such a multicast, our solution requires that only the node with the most remaining energy multicast. In addition, we suggest a reliable multicast transmission via the MAC layer for our model.

The study gives a quick overview of the routing protocol in MANETs, as well as the requirements for reliable multicast over various topologies and alternative congestion control mechanisms. In comparison to well-known protocols, our simulation findings demonstrated that the model generates better outcomes in terms of delay, and throughput.

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