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A Novel Scheme for Congestion Control in Mobile Ad Hoc Networks

S.TamilSelvi[1], O.P.UmaMaheshwari[2]

Research Scholar, Dept. of Computer Science, P.K.R Arts College for Women, Gobichettipalayam.[1]

Assistant Professor, Dept. of Computer Science, P.K.R Arts College for Women, Gobichettipalayam.[2]

Abstract: MANET is one of the important and improving networks in many applications. In MANET, the nodes in the network are self-configuring, without any access points. So, Congestion is considered as important factor which deteriorate the performance of entire network. Due to self-configuring nodes, consumption of energy is high. To avoid this, energy efficiency is needed. In this paper, we developed Energy Efficient Scheme for Congestion Control (EESCC), to improve the energy efficiency of the nodes. Multipath routing is needed to control congestion. Retransmission of packets is minimized by calculating the data energy level and acknowledgement packets. With the help of extensive simulation, this scheme provides minimum consumption of energy and high packet delivery ratio and low delay.

Keywords: MANET, Packet loss, Congestion control, Routing, Energy consumption model.

1. INTRODUCTION

1.1 Mobile Ad hoc Network (MANET)

A Mobile ad hoc network is one of the types of ad hoc network. The term ad hoc refers to "for this purpose" and the devices establish connection when there is a need. MANET is a kind of wireless ad hoc network and to establish the connection between the devices, Wi-Fi is used or some other mediums such as cellular transmission and satellite. Devices in MANET can move in any direction independently. Lots of issues are there in designing a MANET [1]. Each node (Mobile device) acts as a router in MANET. The nodes are responsible for forwarding the packets from source to destination. In MANET, the nodes can be of any type such as laptops, PDAs and mobile phones [2]. Some of the applications are military applications, Civilian environments and Emergency operations.

1.2 Congestion in MANET

Congestion occurs in communication networks when large numbers of packets are presents in subnet. It also occurs when the numbers of packets to be sent to network is greater than the network can handle. Congestion results in the packet loss, bandwidth degradation etc. In internet, congestion occurs normally in a single router whereas the congestion in MANET has effect on the entire coverage area.

Congestion in MANET results in,

Long delay: When there is a long delay in receiving the packets, congestion is severe. Selecting a new alternate path is better. But the existing protocol delays in searching new route.

Packet Loss: Techniques in the congestion control attempts to reduce the excess load by reducing the sending rate or by dropping the packets. It leads to increased rate of loss of packets.

1.3 Congestion Control in MANET

Congestion controlling and providing security are considered to be a major task in MANET. It works well in TCP. As MANET is dynamic topology, congestion control remains a challenging task in Mobile ad hoc network. Many techniques have been proposed for controlling congestion in MANET. The main aim of any congestion control algorithms is to reduce the traffic which results in the high throughput. It should minimize the end-to-end and also the traffic congestion.

2. RELATED WORK

Imran chowdhury proposed [1] Energy efficient and cooperative congestion control(EECCC) for multicasting in MANET. Their proposed system overcomes AODV and EERCCP. A cooperative multicast tree is built in the first phase and in second phase the admission control scheme is either admitted or rejected based on the output queue size.
In [2], the proposed model controls the congestion in two different steps. Packet loss is mainly due to link failure in the network and also congestion. Most congestion control algorithms not able to distinguish between the loss of packet due to link failure or due to congestion.

In [3], they proposed Cross layered Routing Topology(CRT), which improves the detection of congestion and handling it. With CRT, we proposed a Cross layered Power Conserved Routing Topology (CPCRT), which is to improve the performance of transmission by identifying the packet loss of link failure.
Vishnu kumar[4] proposed congestion and power control technique based on agent in MANET. Here the mobile agent in the source, sending the packet which has the minimum congestion. The status is composed for every node and at last it is delivered to the destination node. Here the nodes are selected based on power level.

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Rajesh babu[5], proposed to develop Energy Efficient Secure Authenticated Routing Protocol(EESARP) for MANETs. It provide security from discovering the route attacks by using the hop-by-hop signatures. Efficient node selection mechanism is used to maximize the lifetime of network and minimize the delay.

3. IMPLEMENTATION OF ENERGY EFFICIENT SCHEME FOR CONGESTION CONTROL

Our proposed scheme consists of three phases. Cross layer based multipath routing is built where the effect of packet loss and packet drop is reduced and load balancing is achieved in the first phase. In second phase, the cross layer model is integrated to the energy consumption model to minimize the consumption of energy in mobile nodes. In third phase, a new packet format is proposed where the congestion level, the energy level and the packet loss level is monitored.

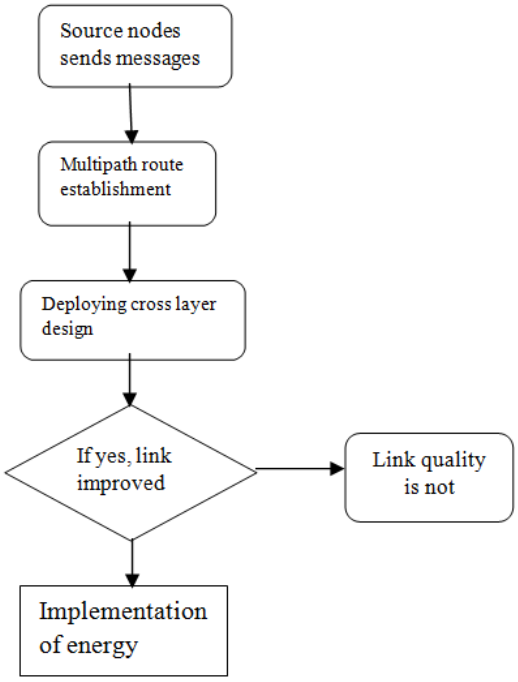

Figure: Flow chart of Proposed Scheme

3.1 Cross layer Multipath Routing

Cross layer design is used to share information in different layers. Multipath routing is a strategy with disjoint links and disjoint nodes. To reduce the packet loss, multipath routing is implemented in our work. Our proposed work mainly focuses to avoid the retransmission of packets as well as the packet loss.

3.2 Energy Consumption Model

In MANET, the nodes consumes more energy when compare to other networks. If there is any link failure, retransmission should be made. To minimize the consumption of energy, the rate of the packet retransmission should be reduced.

The steps of the Energy Consumption model is follows,

Step 1: The energy for the transmission state and the reception state is calculated.

Step 2: The loss of energy of a packet is calculated with the help of the transmission energy, reception energy and probability of the packet loss.

Step 3: The energy for both packets and the acknowledgement packets are determined and the delay is calculated.

Step 4: The total energy for the packets to be transmitted is calculated.

Step 5: The total energy is kept as minimum. Every time, the source node selects the packet to the destination, it will select the path which consumes minimum energy to reach the destination.

Step 6: If the total energy is higher than the threshold, it can be concluded that more packets are lost. Thus, the energy is lost.

3.3 Proposed Packet Format

Source ID	Destina-tion ID	Hop Count	Energy Level	Packet loss ratio	FCS
2	2	1	4	4	2

Figure : Packet Format

The above figure shows the proposed packet format. The source and the destination node each carries two bytes. The third field is the hop count which tells number of nodes which is connected and occupies one byte. Fourth field is energy level, determines the retransmission of packets. Fifth field is packet loss ratio which verifies the loss of packet. Last field is Frame Check Sequence(FCS), used for error detection and correction during transmission.

Algorithm

Step 1:
Determine the energy spent on both transmission and reception.

Step 2:
Compute the energy cost includes losses in the transmission.

Step 3:
Calculate energy spent for both data packet and acknowledgement packet transmission.

Step 4:
Compute the total energy for transmitting a packet.

Step 5:
Define the condition for energy consumption.

4. PERFORMANCE ANALYSIS

The proposed method is integrated with the Dynamic Source Routing Protocol(DSR). This proposed algorithm is implemented using Network Simulator (NS 2.3). In Simulation, 300 nodes are used and the simulation time is 120 seconds. All the nodes have the same transmission range. The simulated traffic used here is Constant Bit Rate(CBR) and Poisson Traffic.

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4.1 Performance Metrics

The performance is assessed by using the following Metrics,

Control Overhead: It defines the total number of routing control packets normalized by the total number of received data packets.

End-to-end Delay: It is the average over all surviving of data packets from Source to Destination.

Packet Delivery Ratio: It is the ratio of total number of Packets received successfully and total number of packets transmitted.

Packet Loss Ratio: It is the ratio of the occurrence of packet lost to the total number of packets.

Energy Consumption Level: It keeps the energy level of the node spent for spending and receiving a data to the total energy spent on the network.

Network Lifetime: It presents the lifetime of nodes spent on route maintanence phase.

Table: Analysis of Proposed Method(EESCC) and Existing Methods(ECAS and CLSMRSCA)

Metrics	EESCC	CLSMRCA	ECAS
Packet loss Ratio(%)	11-55	20-60	25-90
Packet Delivery Ratio(pkts)	45-92	23-75	7-15
Network Lifetime(msec)	19-90	17-39	11-32
End to End delay(msec)	20.2-25.9	28.2-25.2	29.2-27.4
Energy Consumption (joules)	14.2-6.9	16.9-78	17.2-45.8

The above table shows performance analysis of the Proposed System and the Existing system.

5. CONCLUSION

Mobile nodes are moving on random without any control in MANET. So, the losses of packets are common and retransmission of packets occurs frequently. High level of energy is consumed in this case. So, we have developed energy efficient scheme for congestion control attains more energy efficiency and minimize the congestion. Three phases in the proposed system achieves high throughput, minimize the energy consumption of data packets. With the help of extensive simulation, improved packet delivery ratio, low delay and high network lifetime are achieved.

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