ENERGY EFFICIENT COOPERATIVE LOAD BALANCING AND DYNAMIC CHANNEL ALLOCATION MECHANISM IN MOBILE AD HOC NETWORKS

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ABSTRACT

An Energy Efficient -TRACE protocol (EE-TRACE) is introduced to avoid receiving a duplicate of the same packet in the mobile Adhoc network, and improve the energy efficiency. In EE-TRACE protocol, the IS packets include source ID and the packet sequence number. The informations in the IS packets are used to avoid receiving a duplicate of the same packet. An Efficient cluster head selection is done by using remaining battery and node stability. The proposed system introduced a novel MAC protocol, CDCA-TRACE, which combines dynamic channel allocation and cooperative load balancing algorithms to achieve efficient channel allocation and load balancing. The proposed method achieves high performance in terms of end to end delay, Throughput and energy consumption.The proposed EE-TRACE protocol is used to avoid duplicate of the same packet and improve energy efficiency.

Keyword : MH-TRACE protocol, Channel Allocation and load balancing.

I. INTRODUCTION

In an ad-hoc network, each node moves independently which are exchange their information with others using multihop wireless links . Each node in the network acts as a router and forwarding the data packets to other nodes. Due to the node movement, topology of the network is varying dynamically. The MANETs have several salient characteristics such as Dynamic topologies, Bandwidth-constrained, Energy-constrained operation, Limited physical security etc [1].

For improving and automating the quality of service of the networks, proficient resource allocation methods are required. If traffic varies significantly, then resource allocated in the statical manner is insufficient or under-exploited [2] . It resource allocation is crucial for the medium access control (MAC) protocol of a MANET. It only manages bandwidth the utilization, does not adapted to dynamic environment [3] [4].

The MAC protocols for Adhoc network classified into two types [5]. They are coordinated and uncoordinated MAC protocols. In uncoordinated protocols, the nodes compete with each other to share the common channel. In uncoordinated protocols, the bandwidth is efficient when the network has low loads and the network load increases, their bandwidth efficiency is decreases.

For low network loads, these protocols are bandwidth efficient due to the lack of overhead. However, as the network load increases, their bandwidth efficiency decreases. Also, due to idle listening, these protocols are in general not energy efficient. On the other Resource allocation is carried out in a static manner on the hours to

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month's scale of time in telecommunication networks. The Coordinated channel access methods offered quality of service (QoS), reduce energy dissipation, and increase throughput for large networks [6].

Vishnu Kumar Sharma et.al introduced a resource allocation technique to Mobile Ad Hoc Networks. In order to achieve quality of service the proposed system introduced an Agent based Bandwidth Reservation Routing Technique in Mobile Ad Hoc Networks. The mobile agents are forwarding the packets through minimum cost, congestion and bandwidth path. The every node status is collected in the network. The intermediate nodes are used to determine the available bandwidth on the link. After completing the new bottleneck bandwidth field updation the informations are feedback from destination to source [7]. The resource reservation technique is introduced to bandwidth reservation, if the available bandwidth is larger than the bottleneck bandwidth, then bandwidth reservation for the flow is executed. However it does not consider the load balancing.

Lin Gao et.al introduced a Multi-radio Channel Allocation scheme. In order to overcome the channel allocation problem the proposed system is introduced. The proposed min-max coalition-proof Nash equilibrium (MMCPNE) channel allocation scheme used to increase the achieved data rates of communication sessions. The min-max coalition-proof Nash equilibrium (MMCPNE) channel allocation scheme is executed in game [8]. Finally the system introduced hybrid game involving both cooperative game and non cooperative game into our system in which the players within a communication session are cooperative and among sessions, they are non-cooperative. However it only considered Channel Allocation.

Bora Karaoglu et.al introduced a Cooperative Load balancing and Dynamic Channel Allocation scheme in Cluster-Based Mobile Ad Hoc Networks. The Cooperative Load balancing and Dynamic channel allocation (DCA) algorithm executed based on spectrum sensing. In cooperative load balancing algorithm, the nodes select their channel access providers based on the availability of the resources. Dynamic Channel Allocation scheme is introduced for increases the importance of bandwidth efficiency while maintaining tight requirements on energy consumption delay and jitter. The proposed scheme is integrated into TRACE protocol. The CDCA protocol achieves higher bandwidth efficiency [9]. However it does not avoid duplicates of same packets.

II. Proposed System

1. Creation of network

An undirected graph G (V, E) where the set of vertices V represent the mobile nodes in the network and E represents set of edges in the graph which represents the physical or logical links between the sensor nodes. Nodes are placed at a same level. Two nodes that can communicate directly with each other are connected by an edge in the graph. Let N denote a network of m mobile nodes, $N_1, N_2, \dots N_m$ and let D denote a collection of n data items $d_1, d_2, \dots d_n$ distributed in the network. For each pair of mobile nodes N_i and N_j, let t_{ij} denote the delay of transmitting a data item of unit-size between these two nodes.

2. MH-TRACE protocol

In MH-TRACE, particular nodes consider as channel coordinators, which is called cluster-heads. All CHs broadcast the periodic Beacon packets for announce their attendance to the nodes in their neighborhood. If the node does not receive Beacon packet from any CH for a predefined amount of time, it assumes the role of a CH. This method guarantees the existence of at least one CH around every node in the mobile adhoc network. In this protocol time is divided into super frames of equal length. It further divided into frames. By utilizing any one of the frames in super frame, every CH operates. The CH offers channel access to nodes within its communication range. Each super frame divided into sub frames. They are control sub-frame and data sub-frame.

The control sub-frame is used for signaling among nodes and the CH, and the data sub-frame is used to transmit the data payload. In Beacon slot, the Cluster head broadcast their survival and the number of available data slots in the present frame. The CHs working in the same frame means, the interferes is occurred. The CA slot is used to determine the interferences. The mobile nodes are broadcast their channel access requests to cluster head by using Contention slots. After listening to the medium, it makes the schedule to nodes. Then CH sends a header message to nodes which containing transmission schedule. The nodes send short packets summarizing the information in IS slot. By listening to the IS packets, receiver nodes become aware of the data that are going to be sent and may choose to sleep during the corresponding data slots.

3. Dynamic Channel Allocation for TRACE

DCA-TRACE consists of two extra mechanisms. They are i) method to maintain track of the interference level from the other CHs in each frame; and ii) a method to sense the interference level from the transmitting nodes in each data slot in each frame. The interference level of the Beacon and CA slots are updated with the measured values in that frame using

$$I_{k,t} = \begin{cases} M_{k,t} & \text{if } I_{k,t-1} < M_{k,t} \\ (1-\alpha) I_{k,t-1} + \alpha M_{k,t} & \text{o.w} \end{cases}$$

Where,

$I_{k,t}$ and $I_{k,t-1}$ repesent the interference levels of the kth slot in the present and the previous super frame respectively.

$M_{k,t}$ - measured interference level of the k th slot in the current super frame

a - smoothing factor

In DCA-TRACE, CHs mark a frame as unavailable if there is another cluster that uses the frame and resides closer than a certain threshold, Trintf , measured through the high interference value of that frame. Even under high local demand, CHs refrain from accessing these frames that have high interference measurements, in order to protect the stability of the clustering structure and the existing data transmissions. At the end of each superframe, CHs determine the number of frames that they need to access, m, based on the reservations in the previous frame. Depending on the interference level of each frame, they choose the least noisy m frames that have an interference value also below a common threshold, Thintf . If the number of available frames is less than m, the CHs operate only in the available frames. Thintf prevents excessive interference in between co-frame clusters that can potentially destabilize the clustering structure.

4. Collaborative Load Balancing for TRACE

In DCA-TRACE protocol, once CH1 allocates all of its available slots, an additional frame is selected by using algorithm. If other frames interference level is large, additional frame selection is not possible. And also, accessing additional frames increases interference on the IS and data slots of the new frame and decreases the potential extent these packets can reach. To overcome this problem, the system introduced CMH-TRACE and CDCA-TRACE. These are add cooperative CH monitoring and reselection on top of MH-TRACE and DCA-TRACE, respectively. In this CMH-TRACE and CDCA TRACE, the nodes always monitor the presented data slots at the cluster heads by using Beacon messages. The cooperative load balancing algorithm is triggered once all the obtainable data slots for a CH are allocated with a probability p. The cooperative load balancing algorithm is triggered by active nodes in the network. When the cooperative load balancing mechanism is triggered, the node that is presently using a data slot from the heavily loaded CH contends for data slots from other nearby CHs while maintaining and using its reserved data slot until it secures a new data slot from another CH.

The load balancing algorithm triggered for probabilistically reduces the load. An introduced Cooperative load balancing method is does not alter the clustering structure. The load cannot transfer to nearby CH while the source nodes may not be in the surrounding area of another CH. To solve this problem DCA algorithm is required.

The proposed system includes additional frame selection algorithm of DCATRACE with some delay. A fully loaded CH resets a counter, $N_{DCA} = 0$, and starts incrementing it at the beginning of each super frame while it remains fully loaded. The CH attempts to (subject to the interference levels in the frames) access an additional frame when NDCA >= TDCA. It offers time for the active member nodes to trigger the cooperative load balancing algorithm and transfer their load to nearby CHs. A small p value leads to a slower response time for the cooperative load balancing algorithm.

5. Energy efficient (EE -TRACE) Protocol

In EE -TRACE, we include the source ID and the packet sequence number in the IS packet, so that nodes that already received a particular data packet avoid receiving a duplicate of the same packet, which saves a considerable amount of energy. The nodes can selectively choose what data to receive based on information from the IS packets, enabling the nodes to avoid receiving multiple receptions of the same packet. In MH-TRACE, certain nodes assume the roles of channel coordinators, here called cluster-heads. All CHs send out periodic Beacon packets to announce their presence to the nodes in their neighborhood. We have to select cluster head based on residual energy and node stability which is having high value and assign them as cluster head.

Residual energy

The residual energy RE can be calculated by using the following formula

$$RE = E_I - E_c(t)$$

Where

E_I - The initial energy of a node

$E_c(t)$ - energy consumed by a node after time t Stability factor computation :

Nodes that are relatively more stable as compared to the others in the localities are given more favorite. The node's stability is computed as the ratio of number of link failures (f_j) and new connection established (C_j) per unit time to the total number of nodes surrounding that node (n_i).

Therefore, stability of a node j is $\frac{c_j+f_j}{n_j}$. As the values of c_j and f_j increase, the stability of the node decreases.

III. Experimental Result

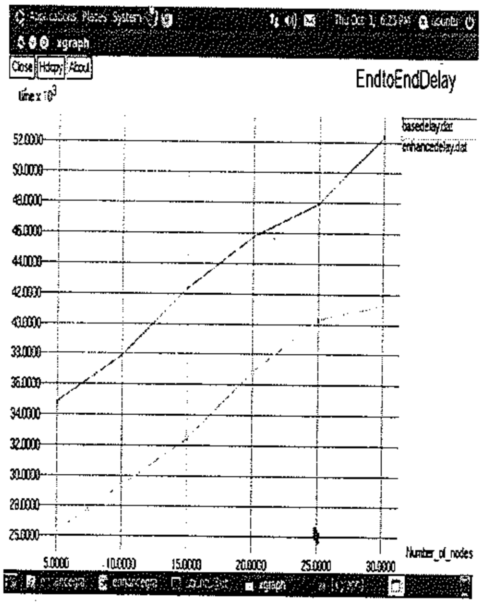
The existing CDCA-TRACE protocol and proposed EE-TRACE protocols are evaluated in terms of end to end delay, packet delivery ratio and Throughput.

Performance evaluation

1. End to end delay

End-to-end delay refers to the time taken for a packet to be transmitted across a network from source to destination.

From the above figure 3.1 can be proved that the proposed methodology provides better result than the existing approach. In this figure x axis plots the number of nodes and y axis plots the time. The time taken for a packet to be transmitted across a network from source to destination is efficient compare to existing one. The proposed algorithm EE-TRACE achieves low end to end delay compared with existing DCA.



2. Energy consumption

Power consumption is the consumption of energy or power.

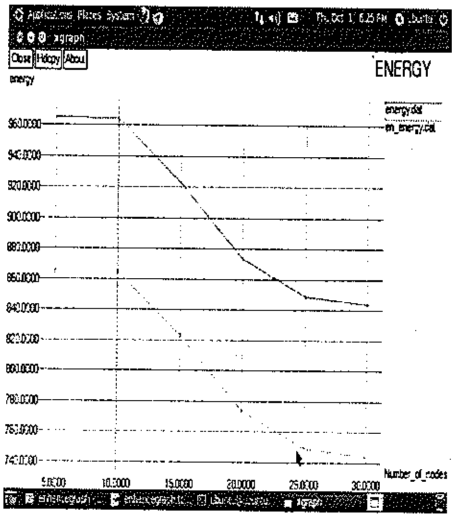
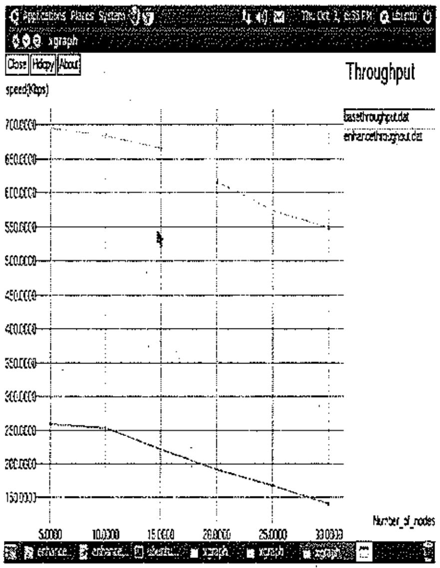


Figure 3.2 : Energy consumption

The Energy consumption of the network is shown is this graph. In the X-axis number of nodes is taken. Y-axis energy of the network is taken. This graph clearly shows that if the number of node is increases the energy of the network is decreased using existing DCA. The proposed algorithm high energy efficiency compared with existing DCA.

3. Throughput

It is defined as number of packets successfully delivered to the destination. From figure 3.3, x axis plots the number of nodes and y axis plots the Throughput value. This graph clearly shows that if the number of nodes is increases the throughput of the network is decreased.



The rate of successful message delivery over a message channel is high compared to existing one.

IV. Conclusion

The proposed system introduced an EE-TRACE protocol, which is designed to avoid a duplicate of the same packet and achieve high energy efficiency. The coordinator nodes are selected based on remaining battery and node stability. Finally an introduced CDCA-TRACE protocol combines dynamic channel allocation and cooperative load balancing algorithms to achieve efficient channel allocation and load balancing. The experimental results show that the proposed EE-TRACE protocol provides high performance compared to the existing methods in terms of throughput, energy consumption and end to end delay.

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