Bottleneck Analysis in Multi Hop WMN with Optimized Energy and Throughput
Shafeeja M.P\(^1\), Shimna N.V\(^2\)
PG Scholar\(^1\), Assistant Professor\(^2\)
Department of ECE
Royal College of Engineering and Technology, Akkikkavu, India

Abstract:
Energy and throughput optimization in wireless mesh network (WMN) is a crucial challenge for next generation wireless cellular networks. In this paper using a MAC layer based on S-TDMA in multi hop wireless mesh network with continuous power control. Power control and multi-rate functionalities allow optimal throughput to be reached, with lower energy consumption, using a mix of multi-hop and single hop routes. In this develop an optimization framework based on linear programming and solve using column generation process. This column generation process is used to find the energy and throughput optimized ISet (in depended set) used for data transmission. In this paper propose, a bottleneck region created far from gateway in the wireless mesh network so the network consume more energy than bottleneck near from gateway. And the leach protocol is used to minimize the energy consumption in the bottleneck region far from gateway.

Keywords: Wireless mesh network, Energy, Throughput, S-TDMA, Leach protocol.

I. INTRODUCTION

Providing optimized data rate and energy to users, irrespective of their position, is a challenge for next generation cellular networks. In this paper, we consider a wireless mesh network (WMN) consist of gateway, mesh routers and clients. Clients are connected to Mesh Routers (MR) and mesh router connected to the gateway, it interconnects the MRs with the core network (Fig. 1)[1].

![Figure. 1. Wireless mesh network architecture](image)

The MRs aggregate the uplink traffic generated by mobile clients and forward it through multi-hop communications to dedicated MRs, denoted gateways, that bridge the backhaul network to the core network. Downlink traffic goes similarly from the gateways to the MRs then to the clients. We assume that mobile-to-MR and MR-to-MR traffic use independent frequencies. In this Optimizing the capacity of multi-hop wireless networks, and energy. Several works in the literature have studied how to maximize the capacity or to minimize the energy consumption, but the works were done under strong assumptions and tradeoffs between achievable throughputs and energy have received very little attention. Only few papers investigated in WMN with energy and capacity consumption jointly[8]. In 802.11 WLAN analysing the relation between energy minimization and throughput maximization[9].

II. MODELING OF NETWORK

In this work, we using a multi-hop WMN where the MAC layer is based on S-TDMA. In this Each node is equipped with an Omni-directional antenna. At each transmission Its transmit power can be continuously adjusted. The routing through multi hop paths to be computed (see Fig. 1) these flows require several resources to be transmitted. A wireless mesh network(WMN)[7] is a fixed infrastructure that consists of a gateway, mesh routers and gateway. At the time of transmission in each time slot, a node can be either idle, receiving, or transmitting. When transmitting, the transmit power of the node u is denoted Pt(u) and its maximum value Pmax. To reduce energy consumption, turn off a node (Sleep State) when it is not in operation. The nodes have a continuous power control capability to reduce the interferences. When two nodes are communicating, the traffic is sent over the link at a rate. Transmission rate is the result of the use of different modulation and coding scheme MCS. In this consider the both physical link and logical link. Here considering both Logical links and physical link. logical link represent routing over origin-destination pairs. The physical link, described the parameters of the radio transmission, is used for physical layer issues. Physical link is identified by the logical link, transmit power and transmission rate. For communication to be established if each rate r has a corresponding SINR requirement [2], physical link is established if and only if the power received from source in destination is enough to reach the SINR requirement of rate r. If SINR requirements holds at all
receivers so the physical links is said to be an independent set (ISet). ISets can be scheduled without creating any decoding conflict at the same time. The set of physical links is infinite, however I can be reduced to a finite set of minimal ISets with respect to transmission powers. Here only consider ISets in which the transmission rate of links decreases when reduce the transmission power. To avoid this provide a tractable and easily generated set of Isets, column generation is used for generating only useful Isets. By scheduling only ISets, we ensure that the schedule is conflict free.

III. CAPACITY AND ENERGY OPTIMIZATION

The column generation process is used to find the optimized capacity and energy. The problem is split into 2 problems Master formulation and the sub problem. Master Formulation is the two linear programs. The joint routing and scheduling problem can be expressed in two linear programs (LP). The first one maximizes the capacity with an energy budget constraint. The Master Problem to Maximize Capacity (MPMC) is formulated as follows [3]. Second LP minimizes total energy under a capacity constraint that is Master problem to minimize energy consumption (MPME) similar the MPMC. Paths and ISets (variables) are exponential with the size of the network, these formulations are not scalable as such. Column generation [4], [5] is a prominent and efficient technique to cope with this situation. Column generation is an algorithmic technique for solving linear programs with an exponential set of variables. Each linear program, denoted master in this context, has an associated and unique dual program. The column generation principle, first solving the master on a restricted set of variables and considering that the non-considered variables are zero. In our case, the variables are the flow over the paths and the weights of the ISets. The table showing the linear program notations using in this column generation process.

(1) Dual Formulation

Below, present the dual formulation of MPMC. Note that the one for MPME is very similar. Recall that in this LP, there is a constraint for each variable of the master, be it the flow on a path or the weighting of an ISet.

(2) Auxiliary Programs

Two auxiliary programs which determine if the ISets that violate the constraints of the dual program. The auxiliary program associated to first constraints of dual program. If the minimum weighted path fits the constraint, then so do all other paths. This problem is similar to the shortest path problem. Hence, it can be easily solved using linear programming (LP). This LP minimizes the weighted path with a conservation flow constraint, which defines the relation between incoming traffic and outgoing traffic for each node [6]. The second auxiliary problem is associated with second constraints of dual programs. It decide if there exists an ISet I. Generation of ISets with continuous power control with that means each node control the transmit power with choose the best MCS and generate a new ISet by solving the mixed integer linear program. Here the goal is to form a new ISet. Finally constraint showing the half duplex property of the link. That means transmission and reception is not simultaneous.

The below graph show the capacity and energy tradeoff in the case of uplink only, downlink only and mix of uplink and downlink. But there is no impact on the energy capacity tradeoff.

IV. BOTTLENECK ANALYSIS OF WMN

In wireless mesh network addressed the problem of network capacity and energy consumption optimization in WMN using a MAC layer based on S-TDMA. A set of novel linear models using a column generation algorithm was presented. The later computes a linear relaxation of the Routing and Scheduling Problem with a realistic SINR model and continuous power control. When a bottleneck area is creating in the network, there is no change in the capacity but consume more energy than that of the network with no bottle neck area. Bottle analysis using the LEACH protocol that decrease the consumption of energy in that bottle neck area. The below graph the show the result. In this capacity increases in the wireless mesh network with higher energy consumption without using the leach protocol in a bottleneck area. But in the graph(4) showing capacity versus energy with Leach protocol. Here capacity is high with lower energy consumption. If any bottleneck area created in the wireless mesh network, leach protocol minimise the energy consumption with same capacity. Low-energy adaptive clustering hierarchy (LEA CH) is the first and most popular energy-efficient hierarchical clustering. The algorithm that was proposed for reducing power consumption. In LEACH, the clustering task is rotated among the nodes, based on duration. Direct communication is used by each mesh router to forward the data to the base station (BS). It uses clusters to prolong the life of the wireless mesh network. LEACH is based on an aggregation (or fusion) technique that combines or aggregates the original data into a smaller size of data that carry only meaningful information to all individual nodes.
Network capacity and energy consumption are optimized by reducing transmit power and interferences. We found that the mix of uplink and downlink has no impact on energy and capacity tradeoff. And shown that energy capacity tradeoff in the case of mix of uplink and downlink. Highlighted that the weight distribution has no impact on the energy and capacity, only the congestion area around the gateways neighbourhood is important and influences the energy capacity tradeoff. Bottleneck area far from the gateway consume same capacity but more energy consumption. The energy consumption in that area is high and this problem is solved by using the leach protocol.

V. REFERENCES


