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Maximizing the Overall End-User Satisfaction of Data Broadcast in Wireless Mesh Networks[1]

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Abstract

We study the problem of broadcasting a common, possibly large, content into a wireless mesh network consisting of N end-users and of one or multiple access points that act as gateways to Internet. Each end-user is characterized by a maximum possible reception rate that depends on the distance and on the interface used to communicate with the associated access point. The end-user satisfaction is proportional to the actual rate received. The overall end-user satisfaction is the sum of the satisfaction of each end-user. Our goal is to maximize the overall end-user satisfaction under the constraint that the access points can retransmit at different rates the same common content at most K times.

We show that the problem can be solved by serving the end-users according to a suitable K segmentation, which is a K partition of the end-users that preserves a specific end-user order. When the access points and the end-users have a unique interface, the optimal segmentation can be found in $O(N(K + \log N))$ time by exploiting the convex Monge property of the satisfaction function. When both access points and end-users are equipped with multiple interfaces, the problem becomes computationally intractable, even for a single access point. Polynomial time algorithms are then devised for optimally solving some meaningful particular cases.

Keywords: Broadcast, Single-hop, Multi-Rate, Multi-Interface, Monge property, Dynamic Programming, NP-Completeness

1. Introduction

Wireless mesh networks (WMNs) have received much attention in recent years for implementing large-scale wireless networks in suburban and urban community because of their low-deploying and low-management cost, especially when built from commodity wireless cards and operating over unregulated spectrum [6, 7]. In such networks, some of the nodes serve as gateways for other nodes to access the Internet. Such nodes play both roles of a host and a router, and are typically stationary and not power-constrained. The remaining nodes, called *end-users*, are connected via wireless link to a single gateway. Packets are usually forwarded in a multi-hop fashion to and from the gateway nodes [6], while in a single-hop fashion from

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