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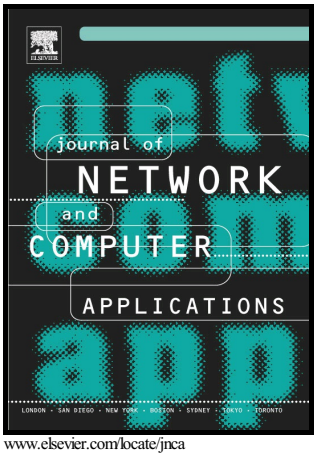

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Improving fairness between close Wi-Fi access points

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Abstract

We consider some Wi-Fi access points (AP) communicating with some stations while being in the carrier sense area of neighbor AP. This corresponds to usual scenarios in local area networks, set-top boxes in houses, intelligent transportation systems... First, using the network simulator N's-3, we observe interesting phenomena, depending on the number of pairs and its parity, confirming previous experiments and models of the literature. Short chains give high disparity in throughput. Moreover, adding a pair (i.e., an AP) can drastically change the throughput of a far ones. We also point out a notable asymptotic behavior. We show that the same phenomena appear while varying the number of stations per AP, the sending rate or the chain geometry. Second, we provide a new analytic model by considering the probability for a station to send data while its neighbors are waiting. This powerful model leads to a non-linear system of equations matching very well the N's-3 simulations. It is callable and permits to study accurately both short and very large chains. In particular, we show interesting properties related to the fairness. Third, we apply our results to some practical cases. Thanks to our model, we are able to compute the optimal settings of the stations for ensuring the fairness in the scenarios listed above.

Keywords: Wireless networks, Wi-Fi, fairness, mathematical modeling, simulation

1. Introduction

1.1. Motivations

Nowadays, wireless local area networks are widely used. The IEEE 802.11 protocol [1] is one of the most deployed. It constitutes the de facto solution for practical network connection, offering mobility, flexibility and low cost of deployment and use. This success leads to many studies of the protocol, in various situations (either ad hoc or with access point) and by different means (experimentation, simulation, modeling). It remains that, besides its qualities, the 802.11 protocol, and particularly its medium access control mechanism, suffers from some imperfections in terms of global throughput and fairness between nodes. Our work deals with some fairness issues with 802.11 protocol.

We study a general scenario, where Wi-Fi communications are close to each other and interfere. More precisely, let us consider some access points (AP) serving some stations (STA). In case the AP are in the carrier sense area of two other AP as in Figure 1, interesting phenomena appear related to the throughput and the fairness. For instance, adding an AP could increase the bandwidth of another far AP.

This scenario is encountered in very common situations. For instance it corresponds to the deployment of an infrastructure-based Wi-Fi network with a set of AP belonging to the same extended service set, for which the