Understanding Fairness and its Impact on Quality of Service in IEEE 802.11

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The Distributed Coordination Function (DCF) aims at fair and efficient medium access in IEEE 802.11. In face of its success, it is remarkable that there is little consensus on the actual degree of fairness achieved, particularly bearing its impact on quality of service in mind. In this paper we provide an accurate model for the fairness of the DCF. Given M greedy stations we assume fairness if a tagged station contributes a share of 1/M to the overall number of packets transmitted. We derive the probability distribution of fairness deviations and support our analytical results by an extensive set of measurements. We find a closed-form expression for the improvement of long-term over short-term fairness. Regarding the random countdown values we quantify the significance of their distribution whereas we discover that fairness is largely insensitive to the distribution parameters. Based on our findings we view the DCF as emulating an ideal fair queuing system to quantify the deviations from a fair rate allocation. We deduce a stochastic service curve model for the DCF to predict packet delays in IEEE 802.11. We show how a station can estimate its fair bandwidth share from passive measurements of its traffic arrivals and departures.

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