The support of multimedia traffic over IEEE 802.11 wireless local area networks (WLANs) has recently received considerable attention. This dissertation has proposed a new framework that provides an efficient channel access, service differentiation and statistical QoS guarantees in the enhanced distributed channel access (EDCA) protocol of the IEEE 802.11e. The framework uses three independent components, namely, a core MAC layer, a scheduler, and an admission control. The core MAC layer concentrates on the channel access mechanism to improve the overall system efficiency. The scheduler provides service differentiation according to the weights assigned to each Access Category (AC). The admission control provides statistical QoS guarantees. The core MAC layer developed in this dissertation employs a P-Persistent based MAC protocol. A weight-based fair scheduler to obtain throughput service differentiation at each node has been used. A measurement-aided model-based admission control to provide the QoS guarantees in both the distributed and centralized scenarios has been developed for the admission control component. A two dimensional Markov chain analytical model for the core MAC layer has been developed. The Markov model provides closed-form formulas for calculating the packet service time, the packet end-to-end delay, and the channel capacity in the unsaturated load conditions. The accuracy of the model has been validated by extensive NS2 simulation tests. The detailed performance results using the NS2 simulator have demonstrated the effectiveness of the proposed framework. Compared to 802.11e EDCA, the scheduler consistently achieved the desired throughput differentiation and easy tuning. The core MAC layer achieved better delays in terms of channel access, average packet service time and end-to-end delay. It also achieved higher system throughput than EDCA for any given service differentiation ratio. The admission control provided the desired statistical QoS guarantees.

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The public is welcome to attend.