ABSTRACT

TCP exhibits unfairness in IEEE 802.11 WLANs due to the high rate of channel errors, frame collisions, and delays associated with wireless transmission. While much existing work has focused on improving TCP throughput in the presence of random data loss and delays, it has not completely addressed the problems that occur when TCP segments are involved in collisions. For example, when TCP acknowledgments (ACKs) collide with data segments, the data almost always survives due to the packet capture effect, while the ACKs cannot be decoded. Excess ACK errors can create unintended behavior in TCP congestion control algorithms, leading to slow data rates and unequal throughput distribution across parallel connections. Fair TCP Channel Access (FTCA) is a comprehensive MAC-layer solution developed to fix these issues. FTCA prioritizes TCP control packets at the MAC layer using quality-of-service mechanisms in the 802.11 standard. It reduces TCP ACK delays and prevents collisions between TCP control packets and data segments that could cause improper protocol operation. FTCA is designed to be easily deployable in existing networks. Using NS-3 network simulations, we perform a thorough comparison of FTCA against other algorithms in capture-enabled WLANs. We show that FTCA significantly improves TCP fairness with minimal throughput overhead.