Cooperation Versus Multiplexing: Multicast Scheduling Algorithms for OFDMA Relay Networks

Abstract:

With the next-generation cellular networks making a transition toward smaller cells, two-hop orthogonal frequency-division multiple access (OFDMA) relay networks have become a dominant, mandatory component in the 4G standards (WiMAX 802.16j, 3GPP LTE-Adv). While unicast flows have received reasonable attention in two-hop OFDMA relay networks, not much light has been shed on the design of efficient scheduling algorithms for multicast flows. Given the growing importance of multimedia broadcast and multicast services (MBMS) in 4G networks, the latter forms the focus of this paper. We show that while relay cooperation is critical for improving multicast performance, it must be carefully balanced with the ability to multiplex multicast sessions and hence maximize aggregate multicast flow. To this end, we highlight strategies that carefully group relays for cooperation to achieve this balance. We then solve the multicast scheduling problem under two OFDMA subchannelization models. We establish the NP-hardness of the scheduling problem even for the simpler model and provide efficient algorithms with approximation guarantees under both models. Evaluation of the proposed solutions reveals the efficiency of the scheduling algorithms as well as the significant benefits obtained from the multicasting strategy.