Robust Provisioning of Multicast Sessions in Cognitive Radio Networks

Today's wireless networks use fixed spectrum over long term and fixed geographical regions. However, spectrum utilization varies by time and location, which leads to temporal and special spectrum underutilization. Therefore, new ways to improve spectrum utilization are needed. Cognitive radio is an emerging technology that enables dynamic sharing of the spectrum in order to overcome spectrum underutilization problem. Users in cognitive radio networks are either primary or secondary users. A primary user is the user who is licensed to use a channel, and has priority to use it over any other user. The secondary user uses a licensed spectrum channel opportunistically when a primary user is idle. Hence, it has to vacate the channel within a certain tolerable interference time when the primary user appears. As a result of this, the secondary user needs to find backup channels to protect the links it is using from primary user's interruption. In this thesis, we concentrate on supporting the multicast service mode using cognitive radio networks. Moreover, we are concerned with supporting this mode of service such that it is robust in the face of failures. The type of failures we are interested in is channel disappearance due to the resumption of activities by primary users. We develop three algorithms which provide robust multicasting in such networks. Our three proposed algorithms are: 1) multicast sessions protection without link-sharing, 2) multicast sessions protection with link-sharing and 3) multicast sessions protection using rings. These algorithms provision multiple multicast sessions, and protect them against single primary user interruption at a time. They also take into account that the activities of a primary user may disrupt communication in several groups, of secondary users, which are referred to as Shared Primary User Risk Group (SPURG). The objective of the proposed algorithms is to increase the number of sessions that can be accommodated in the network and minimize the cost of provisioning the sessions. Multicast sessions protection with/without link-sharing algorithms generate a primary tree for each multicast session, and protect each link of it using a backup tree. Multicast sessions protection with link-sharing allows backup trees to share some links of the primary tree within the same session, and share some links within backup trees for any session. In the third algorithm, a ring is generated where it starts and ends at the source node, and passes through all destination nodes. Also, we compare the performances of our three proposed algorithms. Simulation results show that the number of accommodated sessions in the network increases and the cost of multicast sessions decreases when the number of available channels increases or the session size decreases. Also, multicast sessions protection with link-sharing algorithm outperforms the other two algorithms in terms of the number of sessions in the network. On the other hand, multicast sessions protection using rings achieves the lowest cost for multicast sessions compared with the other two proposed algorithms.