Traditionally, radio spectrum has been statically allocated to wireless service providers (WSPs). Regulators, like FCC, give wireless service providers exclusive long term licenses of using specific range of frequencies in particular geographic areas. Moreover, restrictions are imposed on the technologies to be used and the services to be provided. The lack of flexibility in static spectrum allocation constrains the ability to make use of new technologies and the ability to redeploy the spectrum to higher valued uses, thereby resulting in inefficient spectrum utilization. These limitations have motivated a paradigm shift from static spectrum allocation towards a more ‘liberalized’ notion of spectrum management in which secondary users can borrow idle spectrum from primary spectrum licensees, without causing harmful interference to the latter- a notion commonly referred to as dynamic spectrum access (DSA) or open spectrum access. Cognitive radio, empowered by Software Defined Radio (SDR), is poised to promote the efficient use of spectrum by adopting this open spectrum approach.

In this dissertation, we first address the problem of dynamic channel (spectrum) access by a set of cognitive radio enabled nodes, where each node acting in a selfish manner tries to access and use as many channels as possible, subject to the interference constraints. We model the dynamic channel access problem as a modified Rubinstein-Stahl bargaining game. In our model, each node negotiates with the other nodes to obtain an agreeable sharing rule of the available channels, such that, no two interfering nodes use the same channel. We solve the bargaining game by finding Subgame Perfect Nash Equilibrium (SPNE) strategies of the nodes. First, we consider finite horizon version of the bargaining game and investigate its SPNE strategies that allow each node to maximize its utility against the other nodes (opponents). We then extend these results to the infinite horizon bargaining game. Furthermore, we identify Pareto optimal equilibria of the game for improving spectrum utilization. The bargaining solution ensures that no node is starved of channels.

The spectrum that a secondary node acquires comes to it at a cost. Thus, it becomes important to study the ‘end system’ perspective of such a cost, by focusing on its implications. In particular, we limit our interest to the problem of incentive based routing in DSA networks, where each secondary node having a certain capacity incurs a cost for routing traffic through it. We propose a path auction scheme in which each secondary node announces its cost and capacity to the routing mechanism, both of which are considered as private information known only to the node. We design a route selection mechanism and a pricing function that can induce nodes to reveal their cost and capacity honestly (making our auction truthful), while minimizing the payment that needs to be given to the nodes (making our auction optimal). By considering capacity constraint of the nodes, we explicitly support multiple path routing. For deploying our path auction based routing mechanism in DSA networks, we provide polynomial time algorithms to find the optimal route over which traffic should be routed and to compute the payment that each node should receive.

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The public is welcome to attend.