Cellular spectrum is a limited natural resource becoming scarcer at a worrisome rate. To satisfy users’ expectation, researchers and practitioners recognized the necessity of more utilization and pervasive sharing of the spectrum. Though scarce, spectrum is underutilized in some areas or within certain operating hours due to the lack of appropriate regulatory policies, static allocation and emerging business challenges. Dynamic Spectrum Access (DSA) enables a cellular operator to participate in secondary spectrum sharing in many ways, such as geological database and cognitive radios and it is questionable if they will be sufficient to meet the future expectations of the spectral efficiency. Along with the secondary sharing, spectrum sharing among primary users is emerging as a new domain of future mode of pervasive sharing. We call this type of spectrum sharing as “pervasive spectrum sharing (PSS)". However, such spectrum sharing among primary users requires strong incentives to share and ensuring a freeriding-free cellular market.

Freeriding in pervasively shared spectrum markets is a real techno-economic challenge to be addressed. In a PSS market, operators will share their resources with primary users of other operators. Small operators with lower quality service may freeride on large operators’ infrastructure. Even worse, since small operators’ users may perceive higher-than-expected service quality for a lower fee, this can cause customer loss to the large operators and motivate small operators to continue freeriding with additional earnings from the stolen customers. Thus, freeriding can drive a shared spectrum market to an unhealthy and unstable equilibrium. In this work, we model the freeriding by small operators in shared spectrum markets via a game-theoretic framework. We focus on a performance-based government incentivize scheme and aim to minimize the freeriding issue emerging in such PSS markets. We present insights from the model and discuss policy and regulatory challenges.