Title: Rapid Node Cardinality Estimation in the Internet of Things Using Reinforcement Learning with Applications to Smart Onion Storage Systems

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India is the second largest producer of onions. Onion production in India is seasonal and so the crop is stored in large storage facilities for year-long use. However, these storage facilities lead to 20%-40% wastage due to rotting, sprouting, rooting, etc. The overarching theme of this project is the design and development of an IoT based SMART storage system consisting of a network of sensors that continually monitor humidity, temperature and other parameters to minimize rotting. Within this broad goal, the primary focus of this project is the design of MAC layer protocols for the IoT based sensor network that enables optimal allocation of limited wireless resources. IoT sensors are low energy devices that frequently go to sleep mode to save power.

A key challenge in the MAC design is to estimate the total number of active nodes at any given moment. Once the active node cardinality is known at the base station, the scheduling can be easily done using existing algorithms. Therefore, the goal of this project is to develop novel algorithms for node cardinality estimation, and we adopt a learning paradigm to this end based on Multiagent Reinforcement Learning (MARL). We will develop novel algorithms for MARL that has provably optimal guarantees on performance, and use them to develop new node cardinality estimation algorithms. Our algorithms will be designed to address practical considerations such as heterogeneity of the nodes (some nodes have more important and urgent data to transmit than others), and the setting of mobile base station.