Abstract

Efficient placement and utilization of different resources is an important problem in different types of large scale networks. Such scheduling problems become more challenging in the presence of mobile entities, with possibly different scheduling constraints at different locations. In this thesis, we primarily focus on designing scheduling algorithms for efficient resource allocation for some problems in two types of large scale mobile systems, vehicular ad hoc networks (VANET), and electric vehicles in smart grids.

Vehicular ad hoc networks consist of moving vehicles and road-side units (RSUs), with potential for vehicle-to-vehicle, vehicle-to-RSU, and RSU-to-vehicle communications. The RSUs are usually connected to the internet through some backbone network. When a RSU broadcasts a message from it, all vehicles in its range can receive the message. Many future VANET applications will require events of different kinds to be delivered to moving vehicles within some validity period, without requiring the vehicles to deviate much from their routes. In this thesis, we first investigate the use of the publish-subscribe framework for such environments in which a service provider (SP) delivers events to a set of vehicles that subscribe to them within some given deadlines through RSUs placed along the route of the vehicles. We formulate the problem of event notification to moving vehicles from RSUs under different constraints where a central SP has complete control of the RSUs, and design centralized offline and online scheduling algorithms for low cost event dissemination. We also formulate the problem of event notification from RSUs with finite capacity under different constraints where there are multiple SPs in a city, each controlling a set of RSUs with limited information about other SPs, and design distributed scheduling algorithms that SPs will run to collaborate among themselves for low cost event dissemination.

The next large scale mobile system that we explore in this thesis is networks of electric vehicles (EVs) in smart grids. EVs are an eco-friendly and cost-effective alternative over conventional vehicles driven by internal combustion engines. EVs consume relatively high power from the grid during charging. Hence, uncoordinated charging of a large number of EVs may strain the electrical grid beyond its capacity, leading to potential grid failures. Therefore, scheduling the charging of EVs is an important problem. In this thesis, we formulate the problem of charge scheduling of EVs by a single aggregator under different user and aggregator constraints, and design centralized offline and online scheduling algorithms to optimize different objectives. We also formulate the problem of charge scheduling of EVs under different user and aggregator constraints where there are multiple aggregators in a city, each controlling a set of charging stations and EVs with limited information about other aggregators, and design distributed scheduling algorithms for inter-aggregator collaboration to optimize different objectives.