MARKET-BASED BANDWIDTH ALLOCATION FOR TARGET TRACKING IN WIRELESS SENSOR NETWORKS

by

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ABSTRACT

This thesis addresses the problem of providing congestion-management for a shared wireless sensor network-based target tracking system. In many large-scale wireless sensor network target tracking scenarios (e.g., a surveillance system for tracking vehicles in urban environments), multiple moving targets may converge within close proximity of each other. Network congestion may be incurred in such scenarios as nearby sensors attempt to concurrently send updates to a data aggregation/processing point (e.g., base station). This problem would be further complicated by two additional factors. First, such a large-scale sensor network may very well be deployed to serve multiple target tracking applications with different and dynamic priorities and interests in different (types of) targets. Second, each application will most likely place a different premium on the timeliness of the target information (principally defined by certain quality metric) they receive. All the above challenges introduce formidable challenges in providing the expeditious delivery of target information to all prioritized military applications within the shared sensor network.

Instead of developing a centralized solution, we advocate the use of a distributed auction-based approach to improve the local decision making on network bandwidth allocation in the described context. We use the Second Price Auction mechanism (to ensure incentive compatibility) in which the congested node acts as the auctioneer and the packets carrying target updates act as bidders. Their bid values are defined by the loss of information utility to the applications associated with the packets. The winning packet receives the current transmission slot of the auctioneer node. Based on the simulation result, we demonstrate that the resulting auction allocates bandwidth efficiently, maximizing the collective applications' goals, even when the application priorities change dynamically.