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## Occupancy Estimation with Wireless Monitoring Devices and Application-Specific Antennas

### Abstract:

The rapid proliferation of wireless devices offers new means to infer current conditions surrounding mobile users, their locations, and their actions. This is especially true for industrial, scientific and medical (ISM) radio bands where communication protocols are often open and information about neighboring devices abounds. This article examines efficient occupancy estimation based on Wi-Fi metadata, with an emphasis on algorithms attuned to directional antenna technology. Certain Wi-Fi interfaces can be switched into monitoring mode, an operating state where all local packets are observed and recorded. Using a network of such monitoring sensors, it is then possible to estimate the number of active devices within a specific area. The envisioned estimators take as input received signal strength indicators and media access control addresses. By using directional monitoring antennas, one can gain additional and/or more discriminating information about current conditions, thereby yielding enhanced occupancy estimates. This work introduces novel estimation algorithms and characterizes the performance gains associated with RF-aware sensing devices. Experimental results based on a prototype implementation of this distributed monitoring system provide further supporting evidence for the proposed techniques.