

On The Design and Capacity Of Wide Area Sensor Networks

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Motivation

Rapid and efficient deployment of mobile sensor network systems remains more of an art than a science. A systematic process for deploying wireless sensor networks requires characterizing the environment as well as the infrastructure. We address this need and develop wireless sensor network deployment processes and evaluate the match between theory and practice.

Goals of Approach

Develop a wireless network deployment process:

- ❖ That covers the target area
- ❖ That ensures that each RF (radio-frequency) cell has enough capacity to carry the expected network load
- ❖ That eliminates or minimizes the effect of all classes of interference

Proposed Process

- ❖ Determine the total area of the proposed monitored zone (Figure 1)
- ❖ Determine the range of an IEEE 802.11b transmission at maximum power (20dBm)
- ❖ Deploy transmitters to spatially cover the target area with maximum data rate
- ❖ Measure initial signal coverage area of each AP (Figure 2)
- ❖ Modify each individual access point's transmit power to adequately support sensor node connectivity virtually while minimizing interference
- ❖ Characterize the terrain between the transmitters and receivers and simulate the effect on the RF signal
- ❖ Characterize the noise floor for each proposed network channel
- ❖ Compare simulation model of RF/Terrain characteristics with measured values to be able to rapidly alter and simulate scenario if needed
- ❖ If values match, modify AP power to prevent dead zones. Otherwise, refine simulation model and iterate over previous three steps.

Netstumbler RF Signal Output

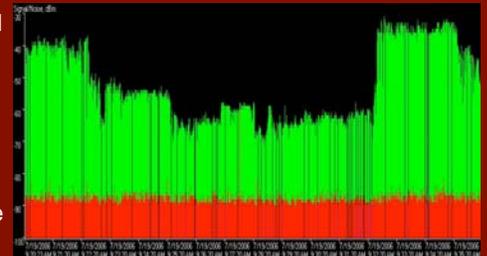


Fig 2. Netstumbler SNR Output:
IEEE 802.11b 2.4GHz
Channel 11 Data rate: 11Mbps

Conclusions

- ❖ Simulation of RF transmission models match (within 10dbm) with measurements
- ❖ Multi-path and interference effects due to the environment force multiple iterations of the process
- ❖ Interference and path-loss detection tools need to improve to characterize multi-path effects

Future Work

- ❖ Automate the deployment process with a complete system tool
- ❖ Examine the effect of interference on Data Packet Loss at the Link Layer



Fig 1. ORNL East Campus Quad:
Example wireless sensor network deployment target area



Fig 3. Access point (AP)
Actual 802.11b transmitter used during wireless survey

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