Institut für Betriebssysteme und Rechnerverbund
Abteilung Distributed and Ubiquitous Systems

Exercises for the lecture

Collaborative transmission in wireless sensor networks

Term: Winter 09/10 Stephan Sigg (sigg@ibr.cs.tu-bs.de) Exercise: 10.11.2009, 08:30 – 09:45

1 Communication in wireless networks

1.1 Wireless sensor networks and application scenarios

Consider the following sensor nodes and application scenarios:

- Jennic JN5139 (Transmission power: 3dBm, Failure rate: 0.7 of 100 nodes in 100 days)
- Jennic JN5121 (Transmission power: 0dBm, Failure rate: 0.8 of 100 nodes in 100 days)

Monitoring of peregrine falcons Over a total observation time of three years, the travel paths of perigrine falcons shall be observed. For this experiment, 10 falcons are prepared with sensor nodes on their legs.

Environmental monitoring In a small forest of $800m^2$ the development of the fauna shall be observed over three years. It was derived that 9283 nodes are required at exposed places to sufficiently monitor this region.

a) For both application scenarios, which node would you propose - and why?

1.2 Calculating with dB

a) At the receiver a power level of $100\mu V$ is measured. What is the power level if the signal is weakened by 40 dB?

b) A base station is transmitting at $5W$. By how many dB is the power increased if the base station transmits at $20W$?

c) A base station is transmitting at 40 dBm. The signal experiences a cable damping of 4 dB until it reaches the antenna. If the antenna gain is 2,5 dBi, of what amount is the effective isotropically-radiated power (EIRP) in dBm and in Watt?

1.3 Multipath propagation

Assume a mobile device to be 20km far off it's communication partner.

a) Of what amount is the time delay between the sending of the signal by the mobile device and the receiving of the signal by the communication partner?

b) Assume a reflecting obstacle behind the communication partner (for example a mountain). Calculate the time delay between the sending of the signal by the mobile station and the receiving of the reflected signal by the base station. The distance between the base station and the obstacle is 100m.

1.4 Pathloss for different wireless technologies

Consider a Jennic sensor node with 3dBm transmission power (antenna gain 0dBi), a mobile station that transmits at 2W in GSM (antenna gain 0dBi), a GSM base station that transmits at 10W (antenna gain 3dBi), a DAB (digital audio broadcasting) transmitter with 1 kW EIRP (230 MHz), a DVB-T (digital video broadcast) transmitter with an EIRP of 10kW (800 MHz). Furthermore, consider a Bluetooth transmitter with 2.5 mW EIRP (2.4GHz) and a Wlan transmitter with 100mW EIRP (2.4GHz). Calculate the signal strength at a receiver at a distance of

a) 10cm

b) 1m

c) 1km

Assume that the receiver has an antenna gain of 0dBi. Note: Antenna gain of a DVB-T roof-mounted antenna with 800MHz: 12dB. Indoor antenna: -2 to 0 dB)