

EENG 460a Homework 2a

1. Propose a new application of sensor networks besides the ones described in class and explain why a sensor network will be a good solution to the problem.
2. Name 6 possible ways for reducing power consumption in a wireless sensor node.
3. Explain the terms data centric routing and data centric storage and give an example paper for each one of them.
4. What are the conditions for unique localizability of a group of sensor nodes?
5. Compare and contrast TPSN and RBS time synchronization protocols and provide a list of setups for which time synchronization from the two protocols would be challenged.

6. TOA with low-cost clocks (from Kaiser & Pottie 9.4, pg. 9.32)

In order to make accurate range measurements in a GPS system, the receiver satellites both need clocks that can be synchronized down to the nanosecond, which potentially could require atomic clocks not only on all the satellites, but also in the receivers. However, atomic clocks are far too expensive for everyday consumer use. GPS sidesteps this problem by measuring the distance to four instead of the minimum three located satellites. Every satellite contains an expensive atomic clock, but the receiver uses an ordinary quartz clock, which constantly resets. With four range measurements, the receiver can easily calculate the necessary adjustment that will cause the four spheres to intersect at one point. Based on this, it resets its clock to be in synch with the satellite's atomic clock, thus providing time as well as location. Explain mathematically how this fourth measurement provides these benefits.

7. TDOA in 3D Space (Kaiser & Pottie 9.6)

Assume that 5 reference nodes are known at $(0,3,0)$, $(6,0,0)$, $(3,4,0)$, $(-4,-3,0)$ and $(0,0,-8)$ respectively. Also $t_{12}=0s$, $t_{13}=1s$, $t_{14}=0.7s$ and $t_{16}=1.7s$. The velocity of propagation is v

- a) Use equation 9.10 (from Pottie & Kaiser) to find the unknown location (x_t, y_t, z_t) in terms of v .
 - b) Now assume that the propagation speed is known as 8.7 m/s. Use 9.12 to find the unknown location (x_t, y_t, z_t) .
8. Consider a set of 4 ultrasonic beacon nodes B1, B2, B3 and B4 attached the ceiling of a room advertising the following x,y,z coordinates:

B1 (100, 100, 300)

B2 (650, 175, 300)

B3 (525, 322, 300)

B4 (320, 130, 300)

An object X in the room, measures the following distances from the beacons:

$$X(B1) = 315$$

$$X(B2) = 423$$

$$X(B3) = 285$$

$$X(B4) = 239$$

Give the coordinates of the object. Show your problem formulation and all steps of your work.

9. State the main results on ad-hoc network capacity for the static and mobile case, and give a short paragraph explanation why capacity increases with mobility.