M2 Info — DEMIPS
Wireless Networking and Sensor Networks

Closed book examination

Please be concise and give a rationale for your answers

January 27th 2011

1 Wireless data and cellular networks (7 points)

1.1) Cite 3 different channel access methods (*i.e.* multiplexing techniques) and give examples of wireless communication technologies using them.

1.2) Cite 2 spread spectrum techniques and for each of them give 1 (if possible 2) example(s) of wireless communication technologies.

1.3) Explain how it is possible that a frame transmission in 802.11b (at the 11Mb/s bit rate) can survive a collision with a frame reaching the receiver with a similar power? By considering a channel width of 22MHz and using the Shannon capacity formula ($C = B\ log_2(1 + SNR)$), how many concurrent transmissions could lead (theoretically) to the successful reception of one of them?

2 Sensor networks (8 points)

2.1) What is 6LoWPAN? What are the main motivations and principles of 6LoWPAN?

2.2) What are the main functional blocks found in a generic node architecture?

2.3) What kind of constraints restrict the technology miniaturization?

2.4) Describe the main differences and interests between the centralized and distributed paradigms?

2.5) A simple distributed averaging consensus in a deterministic case is described by the matrix equation $Y[t] = A\,Y[t-1]$ where $Y[t] = y_i[t]$ is the local average at node i and time t.

(a) What does A mean in this equation?

(b) Why do we not take this equation form when the sensors measurements are random?

(c) Give two applications which use this kind of algorithm as background.

2.6) What are the two main radio technologies that address the needs of location-enabled Wireless Sensor Networks? What kind of location-related radio metrics do they enable to measure/estimate respectively?

2.7) What are the four major phenomena that can affect/alter Round-Trip Time of Flight (RT ToF) measurements based on Time of Arrival (ToA) estimation and Two Way Ranging (TWR) protocol transactions?

2.8) Assume a wireless sensor network with 3 anchors, 5 mobile nodes under full connectivity (*i.e.* a fully meshed network). How many terms take part in the summation accounting for the Least Squares (LS) cost function, if one performs cooperative positioning with non-symmetric range measurements?

2.9) Does the DV-Hop positioning algorithm require distance measurements based on received radio signals (i.e. derived from TOA of RSSI measurements)?

3 Security (5 points)

3.1) (a) Describe the relay attack (example with access card).

(b) Propose a solution to prevent this attack?

3.2) (a) Describe one of the WEP attacks and explain which vulnerabilities it exploits.

(b) Summarize the main differences between WEP, WPA (TKIP), and WPA2 (RSN/AES-CCMP).