

Solution to Exercise # 1

Section 1:

1. Among them:
 - a. Cellular network (0G, 1G, 2G (GSM900/1800), 2.5G (GPRS), 2.75 (EDGE), 3G (W-CDMA, FOMA, UMTS), 4G, etc)
 - b. Bluetooth, an industrial specification for wireless personal area networks (PANs), also known as IEEE 802.15.1 with 1 to 100 metre range based on power class; Zigbee, IEEE 802.15.4 at 10 and 75 metres.
 - c. 802.11 (Wi-Fi) wireless local area networks (WLAN) based on the IEEE 802.11 specifications (802.11a, b, g, n, legacy)
 - d. Others:
 - i. PCS covers GSM and CDMA
 - ii. Wimax 802.16 for Broadband Wireless Access
2.
 - a. They are infrastructure based network with centralized admin. Each mobile-phone connects with corresponding base-station and base-station forward message to other mobile-phone.
 - i. centralized over self-organize/maintain/heal/destroy, e.g find desired route ownself, multihop
 - b. They usually do not have sensors.
 - c. The communication usually involves two mobile phones only, e.g. handy.A to cellular BS to handy.B or relayed by BS. (WSN-data aggregation among many sensor nodes to sink)
 - d. Mobility causes switching of base stations.
 - e. Cost
 - f. Setup complexity
 - g. Sensor: power-limited device and energy determines lifetime. Recharge handy cell :)
 - h. purpose/applications: cellular is more for human-human communications while sensor network can interact to and learn its environment through sensing.
3.
 - a. Cost of infrastructure
 - b. No time to set up a infrastructure (in war)
 - c. Infrastructure break down (disastrous situations or congestion)
 - d. difficult to set up (e.g. base station in forest, underwater)
4. (No answer given): more on section 4
5.
 - a. Number of sensor nodes in sensor network can be several order of magnitude higher than in an ad hoc network
 - b. Sensor nodes are more densely deployed
 - c. Sensor nodes are prone to failure
 - d. The topology of sensor network change more frequently
 - e. Sensor nodes are much more limited in power, computational capabilities and memory.

Section 2:

1. In ideal case:
 - a. Total energy consumption for three hop communication: $d^2 + d^2 + 9 d^2 = 11 d^2$
Total energy consumption for one hop communication: $(5d)^2 = 25d^2$
2.
 - a. Less energy consumption
 - b. Avoiding physical obstacle between to end node (e.g. hills, buildings etc). e.g
Straight line of sight vs. non-linear multihop route.S
 - c. High mobility scenarios (for example: neighbours are not same all the time and nodes distances increase/decrease with time).

Section 3:

- 1) a) Processor b) Memory c) Sensors d) Transceiver/Antenna e)power module
- 2)
 - Type of service of WSN
 - Not simply moving bits like another network
 - Rather: provide answers (not just numbers)
 - Issues like geographic scoping are natural requirements, absent from other networks
 - Quality of service
 - Traditional QoS metrics do not apply
 - Still, service of WSN must be “good”: Right answers at the right time
 - Fault tolerance
 - Be robust against node failure (running out of energy, physical destruction, ...)
 - Lifetime
 - The network should fulfill its task as long as possible – definition depends on application
 - Lifetime of individual nodes relatively unimportant
 - But often treated equivalently
 - Scalability
 - Support large number of nodes
 - Wide range of densities
 - Vast or small number of nodes per unit area, very application-dependent
 - Programmability
 - Re-programming of nodes in the field might be necessary, improve flexibility
 - Maintainability
 - WSN has to adapt to changes, self-monitoring, adapt operation
 - Incorporate possible additional resources, e.g., newly deployed nodes