Telecommunications and Network Engineering Sub-module

Wireless Sensor Networks Assignments

1. (a) 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.

(b) Describe 6 possible ways for reducing power consumption in a wireless sensor node.

What are the key features of Sender-Receiver and Receiver-Receiver synchronization? What are their relative advantages and disadvantages? Which protocol would you use for a target tracking application? Why? The target tracking application works as follows: Initially a small group of co-located sensor nodes detect the target, localize it, and detect its velocity and direction. The packet is forwarded along the direction of the velocity/direction estimate to wakeup other nodes to perform the detection.

3. Consider a video sensor network where one in ten nodes needs to wakeup a single larger video sensor node within 200ms of occurrence of an event. Events occur every 5 minutes on average in the sensor network. SMAC is the MAC protocol used by the system. Every node is within one hop of each other. What should the choice of sleep period in SMAC be to ensure the latency bound while minimizing power?

4. The following undirected graph $G = (V,E)$ with a set of nodes $S = (1, 2, \ldots, 6)$ is given.

a. Describe a flooding mechanism for the given graph. Draw step-by-step all possible routes when source node 1 wants to transmit a packet to destination node 6.

b. There are problems such as routing packets circulating endlessly. Describe appropriate mechanisms to avoid such problems. Draw a possible extended flooding mechanism to the graph.
5. Note the definition of the request zone in the Location Aided Routing (LAR/LBM) protocol. This is the region such that the nodes within this region forward route requests; nodes outside this region do not. There could be many methods of constructing the request zone such that the intended destination exists within this zone. However, the shortest route between the source and the destination must also lie entirely within the request zone for this route to be discovered. Is it possible to construct a non-trivial request zone (non-trivial here means that the request zone that is smaller than the entire network) where the above is guaranteed? Explain.

6. Assume that some links in an ad hoc network is unidirectional. This happens when due to asymmetries in transceiver designs, transmit powers and/or radio propagation environments, a node A can hear another node B, but B cannot hear A. Apparently, this situation is prevalent in wireless communication systems. This creates subtle problems in routing protocols. For example, in the AODV protocol a route request can be propagated along a path which contains one or more of such unidirectional links. Thus, route replies cannot be received along this path. Suggest methods of tackling this problem either by arguing that this is not a problem, or by devising methods of ignoring unidirectional links or using them creatively in the routing protocol. (You can use AODV as the base routing protocol for your answer.)