Wireless Ad Hoc Networking: Quiz 1, October 18, 2010

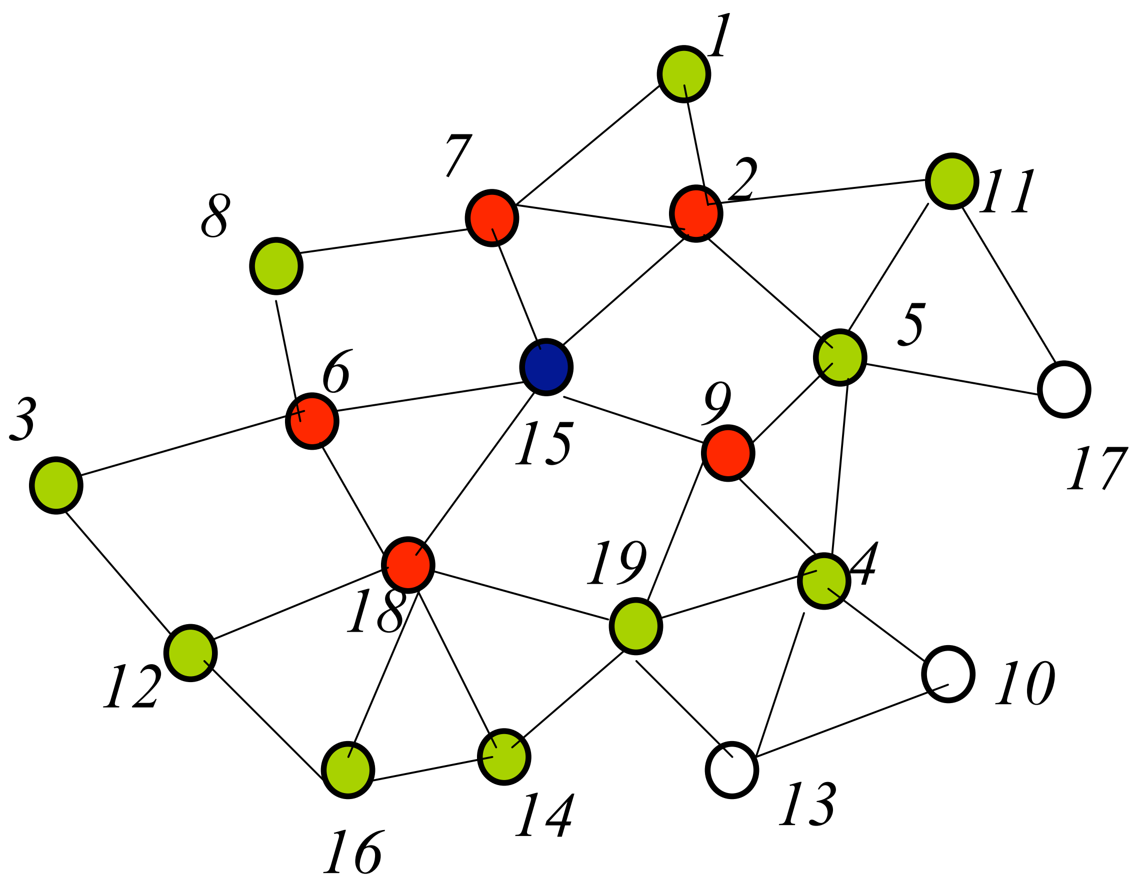
Closed book exam, 120 minutes

Name: ________________________ Student number: _____________________________

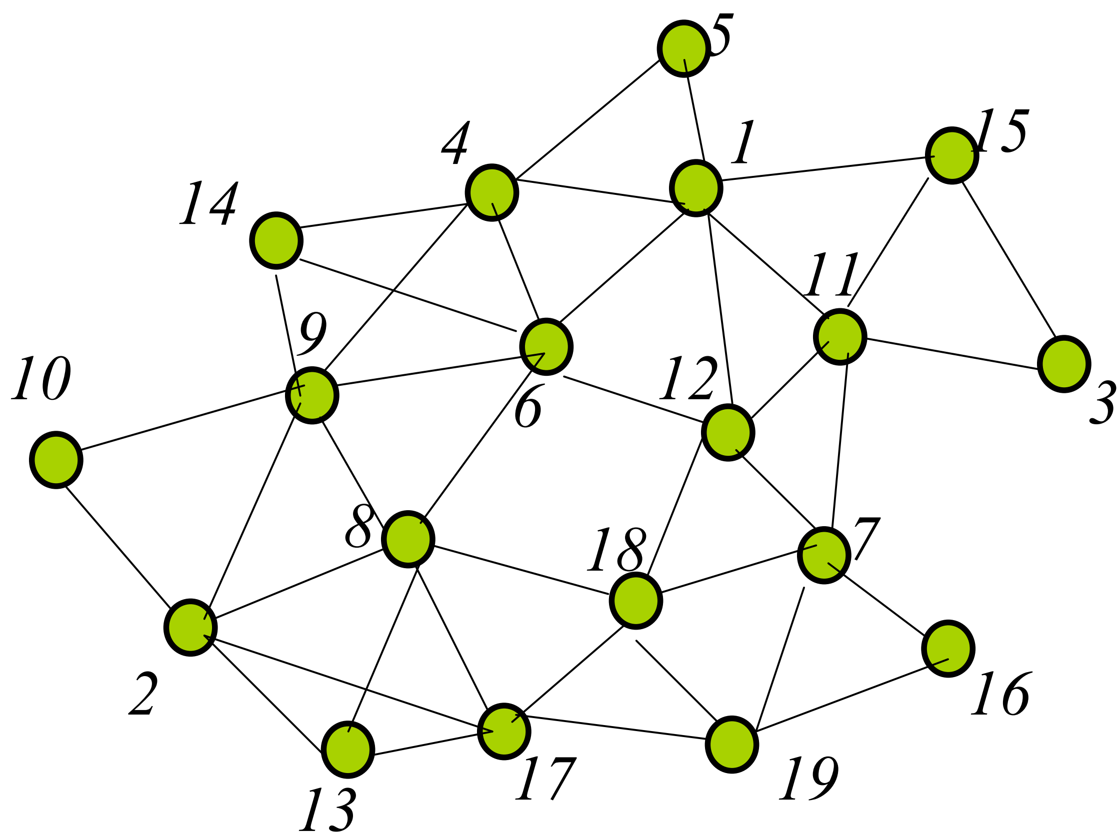
1. (8+8 marks) Node X selects as its relays the minimal number of 1-hop neighbors of X which cover 2-hop neighbors of X. Greedy relay selection algorithm will repeatedly select a neighbor which covers the maximum number of still uncovered 2-hop neighbors. In case of a tie for the selection, choose neighbor with lower ID. Suppose that node 15 is the source node for a broadcasting task.

(1) What are relays of node 15? Note that candidates are 2,7,6,18 and 9. All 2-hop neighbors are also indicated with the same shade. 3-hop neighbors are white.

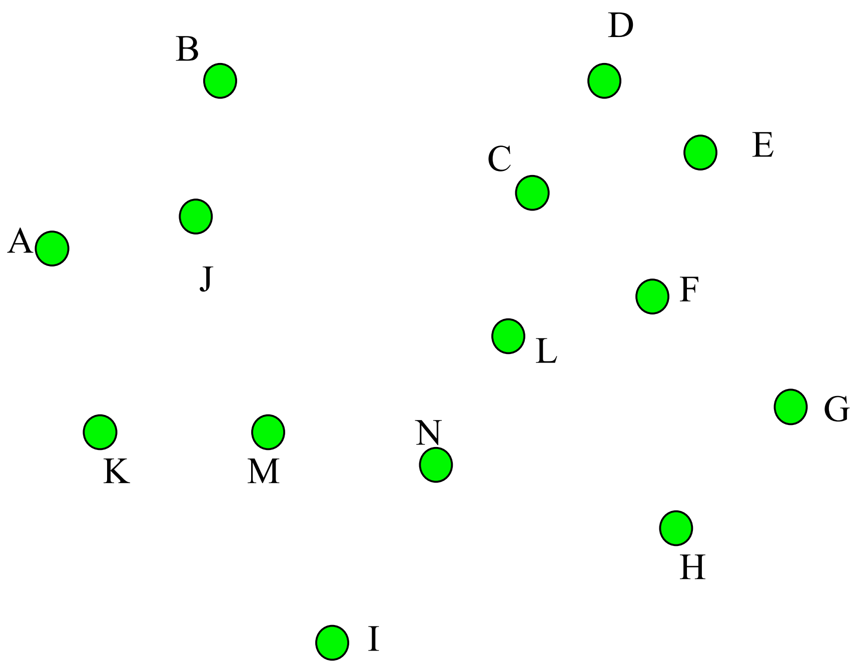
(2) Relay nodes of X first eliminate from their 2-hop neighborhood all nodes known to have received message already, before selecting their own relays. What are relays for each relay of X?



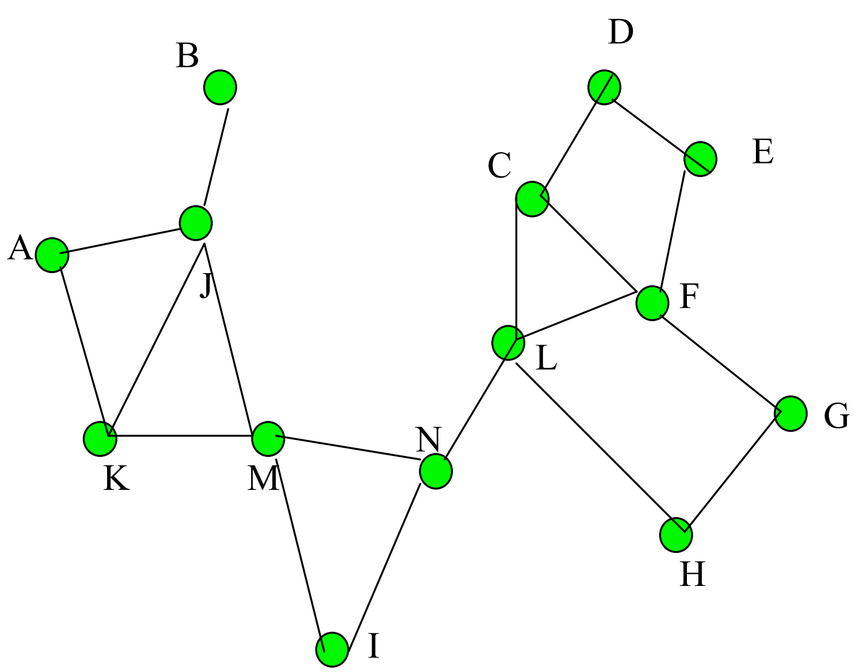
2. (15 marks) Apply the generalized covering rule to determine which nodes do not belong to the connected dominating set. For each such node, list the neighbors that cover it. Node A is covered by neighboring nodes B, C, … if B, C, … are connected (that is, create connected subgraph), any neighbor of A is neighbor of (at least) one of B, C,.. and key(A) < min (key(B), key(C),…). Use key=ID, ordered numericaly (1<2<3<…). Node A is also considered covered is it does not have two unconnected neighbors.

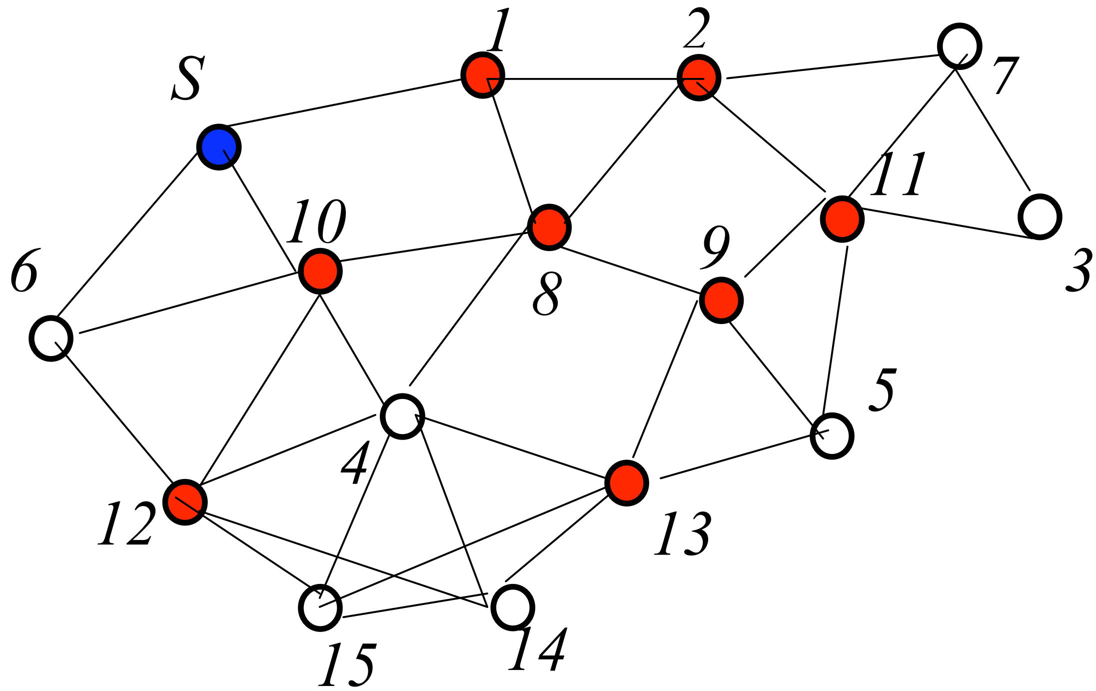


3. (8+8 marks) a) An edge UV belongs to Relative Neighborhood Graph (RNG) of a set S if and only if |UV| is not the longest edge in any triangle UVW (that is, either |UV|≤|UW| or |UV|≤|VW|). Draw RNG for the network below. Simply draw/list edges that you believe are in the RNG.



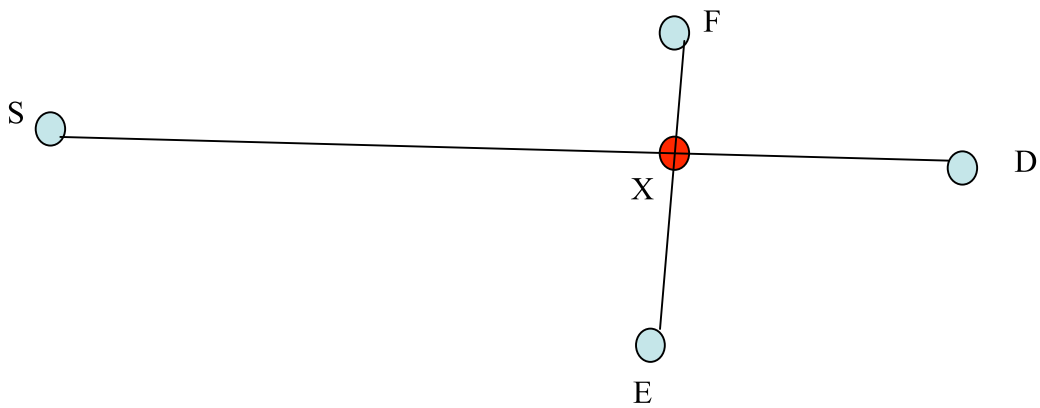
b) Show two recovery paths (by right-hand and left-hand rules) when recovery starts from node B and message is destined for node D. Extend both and show greedy-face-greedy routing steps.

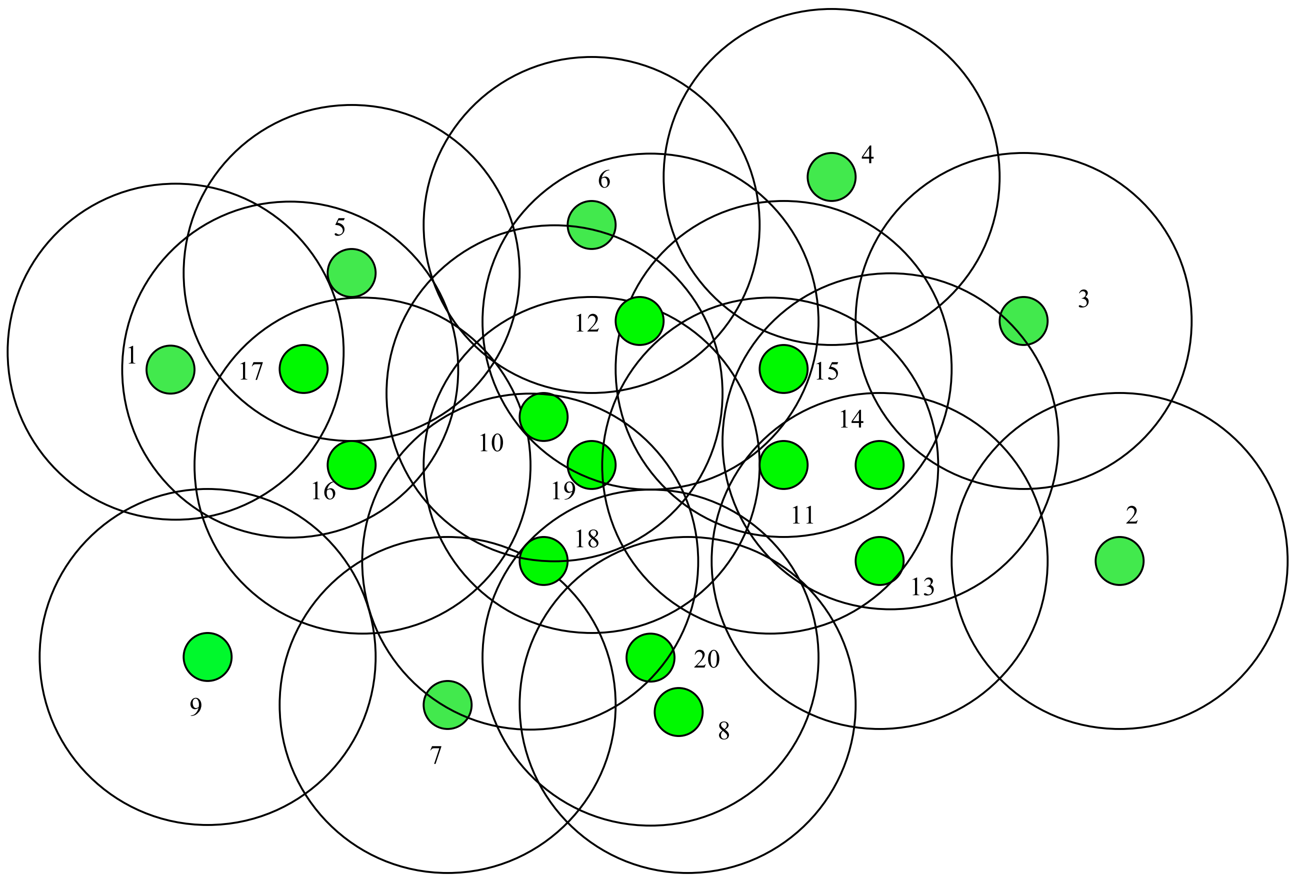




4. (15 marks) Follow **neighbor elimination and dominating set** based broadcasting on above figure, with S as the source node, and nodes 12, 10, 1, 8, 13, 2, 9 and 11 being in the dominating set. The key for timeout comparisons is *(timeout, ID);* that is, if timeouts are same, node with lower ID number will transmit first. For timeout, use formula *timeout=1/(number of uncovered neighbors)*. List nodes that will retransmit in the process, in the order of retransmissions. After each transmission, list which nodes have timeouts and how long are they.

5. (12 marks) Gabriel graph GG(S) contains an edge (U,V) if ad only if the disk with diameter (U,V) contains no other point from the same network. Suppose that line segment SD intersects line segment EF in point X, as in figure. Suppose also that EF belongs to the Gabriel graph of a network which includes nodes S and D (consequently X is not a node network). Prove that at least one of nodes E, F is closer to D than S (that is, |FD|<|SD| or |ED|<|SD|).





6. (16 marks) Localized sensor area coverage algorithm works as follows. Each sensor selects a random timeout. Suppose that timeouts expire in the order as indicated by numbers: 1,2,3,…,20. Assume also that communication range is much larger than sensing range (so all decisions are received by sensing neighbors). Each transmission contains the position of sensor. At the end of its timeout, if sensing area is not fully covered, sensor decides to be active, and informs neighbors. Otherwise it decides to be passive, but still sends a message to neighbors informing about the decision. This is PN variant. What sensors will at the end be active? Suppose also that at the end there is another round of timeout (use same order) for sensors which decided to be active. Each such sensor will decide to be passive if other active sensors cover its area (some of these active sensors decided their status after given sensor). This is a retreat option (PNR variant). Retreat decisions are communicated to neighbors. Which sensors will retreat in this example?

7. (10 marks) Show the expected traversal using the Single Robot BackTracking Deployment (BTD) method (which extends snake like deployment method with obstacles), with the triangle as the starting point. Show regular movement with a solid line and back tracking with a dashed line. Assume the following order of preference for movement in the event of more than one open direction: East, West, North, South. Note that sensors should be deployed at grid points located between two curves.