Exercises of lecture

Wireless Sensor Networks

Winter 2006/2007

Sheet 13

SECTION 1:

Ad Hoc Routing Protocol

1. One of the popular geographic routing in ad hoc network is called Greedy Perimeter Stateless Routing (GPSR) protocol. It assumes that the location of the destination node is known by the source node, and each node knows the location of its neighbors.

   (a) Consider the sensor network in the following diagram, describe the routing based on GPSR when node S wants to transmit a packet to the destination D.
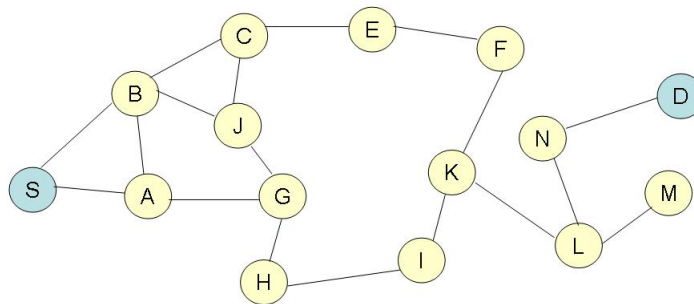
   (b) What is the drawback of *greedy forwarding* in GPSR?

2. Distance vector routing protocol has the drawback of count-to-infinity. AODV is a well-known ad hoc routing protocol that is based on distance vector. How does it ensure loop-freedom?

3. Consider a small-scale sensor network that consists of six sensors. The following depict the route tables maintained by each node.

Route Table of Node 1:

Destination	Next Hop	Hop Count
3	3	1
5	3	2
4	3	2
2	2	1
6	2	3

Route Table of Node 2:

Destination	Next Hop	Hop Count
1	1	1
5	4	2
4	4	1
3	4	2
6	4	2

Route Table of Node 3:

Destination	Next Hop	Hop Count
1	1	1
5	5	1
4	4	1
2	4	2
6	4	2

Route Table of Node 4:

Destination	Next Hop	Hop Count
1	2	2
3	3	1
5	5	1
2	2	1
6	6	1

Route Table of Node 5:

Destination	Next Hop	Hop Count
1	3	2
3	3	1
2	4	2
4	4	1
6	4	2

Route Table of Node 6:

Destination	Next Hop	Hop Count
1	4	3
3	4	2
5	4	2
4	4	1
2	4	2

(a) Draw the topology of the network.

(b) What is the route followed by the packet if node 6 generates a packet to the destination node 1?

Solution:

1. Answer for Question 1:

   (a) Route constructed based on GPSR:
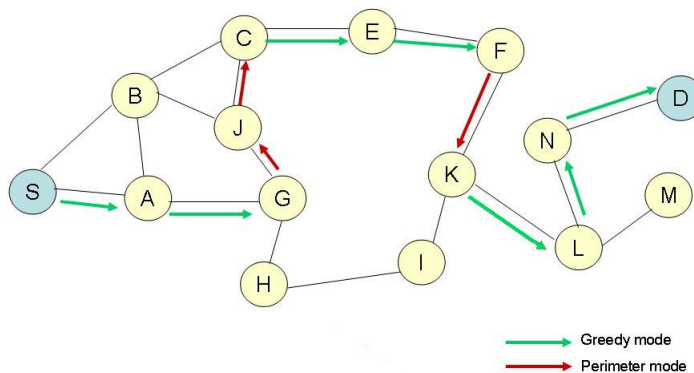
   (b) Since GPSR depends on the knowledge of the forwarding node's immediate neighbors, a node position is critical. However, a node position becomes less current when the mobility rate increases, leading to routing failure.

2. AODV avoids this problem by using the sequence numbers. Each node maintains its monotonically increasing sequence number, which it increases every time it learns a change in the topology of its neighborhood.

   For example, if a link is broken, the node that detects it will increase the sequence number of the unreachable destination in a Route Error (RERR) message and send it to the precursor nodes, which are the nodes that use this route to reach the currently unreachable destinations.

   If you are interested, you can find more information on count-to-infinity problem at *http://computer.howstuffworks.com/routing-algorithm4.htm* and a survey paper on count-to-infinity problem with it solutions at
   http://www.tml.tkk.fi/Studies/T-110.551/2004/papers/Lindqvist.pdf.

3. Answer for Question 3:

   (a) Network topology:
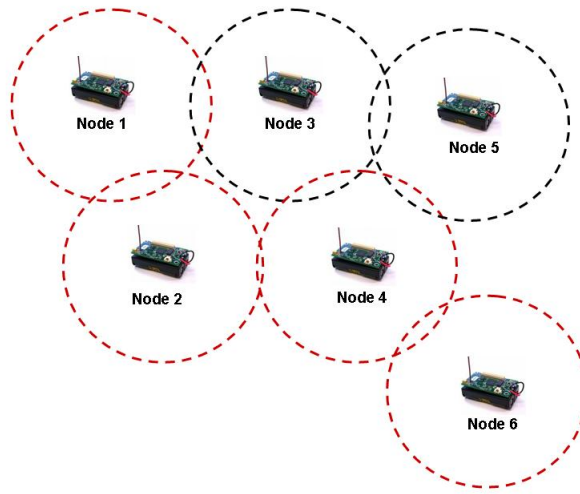
   (b) Route 6-4-2-1 (as highlighted or colored in answer for 3a).