UESTC4020: Wireless Sensor Networks

Lab Session 3 & 4

In these two sessions, you will continue to build upon the knowledge gained in the first two labs. In these labs, we will compare two data centric routing protocol: flooding and gossiping. We will, however, not implement the complete protocol due to time constraint. We will also explore how varying some characteristics might improve the performance. As usual, you will be using matlab to solve the problems.

Flooding

We will first examine flooding protocol. As we know flooding protocol sends packet to all the neighbours within a certain range. The range is normally defined by transmit power (or receive power threshold). For simplicity, we will take a distance-based threshold for coverage. To set up a distance you need to find the distance between sensor nodes and find the required minimum distance to ensure at least one node is in coverage of the other. A simple code is shown below:

```
for i=1:50
    for j=1:50
      Globaldist(i,j)=sqrt((location(i,1)-location(j,1))^2+(location(i,2)-
      location(j,2))^2);
    end
end
```

Note that all diagonal element of the distance matrix will be zero (It represents distance from itself). You can either remove the diagonal elements or find some other way to ignore that for finding the minimum distance for each node. For example, you can assign diagonal elements a very high value (e.g. 10000) and then find the minimum distance for each sensor node as follows (within the for loop of i);

```
    MindistMat(i)=min(Globaldist(i,:));
```

And then sorting them would give you an idea of coverage distance.

```
      MindistMat=sort(MindistMat')
```

Some exploration will show show that except for the sync, the highest minimum distance is roughly 165.88 meter. Including sync, the distance is 222.18 meter.

You need to complete the following task:

Task1 (40%):

Set the distance threshold as 225m. This means, each node can transmit message to all the neighbours within Considering each hop as one time unit, write a program to find how much time unit you will need to reach all the sensor nodes. Message forwarding should stop once all nodes receive the message (you do not need to write code for sending messages, just counting the hops with above condition is fine).

How many nodes are on average within the coverage of each node for the threshold of 225m?

Since each node will broadcast to all of its neighbour within the distance threshold, many of the nodes will receive multiple copies of the same packet. On average how many messages each node received?

Can you comment on how this redundant message transmission be reduced? Can you comment on energy consumption (assume identical energy consumption in each transmission)?

Gossiping and its' variants:

Gossiping solves the message implosion problem by just forwarding the message to a randomly selected neighbour (keep the threshold same as above for selecting the neighbour).

Task 2 (25%):

Write a program for gossiping and find how many time unit it takes to reach all the nodes (it will be very long!).

Task 3 (35%)

In this one, we will see how we can improve the very poor latency performance of the gossiping protocol. To do that, we will increase the number of neighbours to which the message would be forwarded.

Repeat the task 2 where you forward it to 2 neighbours. How many time unit it takes to reach all the nodes?

Repeat the process for number of neighbours increasing up to 6.

Can you make a bar chart of required time units for various neighbour numbers?

Can you make another bar chart of total number of message forwarding required for various neighbour numbers?

Comment on the result obtained. Compare the latency performance with flooding.

Marking Criteria:

Elements	**F-E** **20-39**	**D** **40-49**	**C** **50-59**	**B** **60-69**	**A** **70-100**
Presentation, clarity and communication of ideas (25%)	Poor presentation without meaning and lot of irrelevant material	Elementary presentation with some mistakes and some irrelevant material	Satisfactory presentation with meaning and almost no irrelevant material	Good presentation with clear meaning and no irrelevant material	Excellent presentation with very clear meaning and precisely relevant material
Theoretical/ Mathematical /Technical Content (35%)	Poor or no technical content and analysis without referencing	Elementary technical content and analysis with limited referencing	Satisfactory technical content and analysis with some referencing	Good technical content and analysis with relevant referencing	Excellent technical content and analysis with precisely relevant referencing
Results (40%)	Poor or no results	Elementary results with limited discussion and comparisons	Satisfactory results with some discussion and comparisons	Good results with critical discussion and comparisons	Excellent results with thorough critical discussion and comparisons