Michigan Tech

EE5726: Embedded Sensor Networks

Assignment #04

Akhil Kurup

amkurup@mtu.edu

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Problem 1

What is the main purpose of the MAC layer and why is this challenging in networks with shared media?

A Wireless Sensor Network (WSN) is usually made up of multiple sensor nodes. These nodes usually use a similar technology for communication and therefore share a common wireless channel. When multiple nodes try to communicate their data, data collision and eventual corruption may take place. It is therefore the task of Medium Access Control (MAC) protocols to *regulate access* of the nodes to the network. The MAC forms a sub-layer in the OSI model under the Data Link Layer. It interacts with the medium via the Physical Layer. It is responsible to *decide when a node can have access to the medium* and to *detect conflicts* and try to either *resolve* them or *avoid* them. Resolving potenial conflicts is also an energy consumption issue. Sensing the medium requires substantial amount of energy which leads to trade off in energy efficiency. Several problems like the hidden-terminal and exposed-terminal problems have to be resolved and concerns like signal fading and asymmetrices have to be accounted for. These considerations make MAC protocols challenging.

Problem 2

Consider the network topology in Figure 1, where circles indicate the communication and interference range of each node, that is, each node can hear the immediate neighbors to the left and right. Assume that RTS/CTS is not being used.

a Node B currently sends to node A and node C wants to send to node D. Is node C allowed to do so (i.e., can it do so without causing a collision) and will it decide to do so?

From Figure 1 it can be seen that node C and node D are within range of each others communication. **Since node B is communicating with node A, node C can safely communicate with node D without causing any collission**.

Now, Assuming that a CSMA protocol is being used, before start of transmission, node C will sense the medium. Since node B is communicating with node A, *node C will think that the medium is busy and refrain from communication*. Hence, **no data transmission will take place**. This is a classic case of the hidden terminal problem.

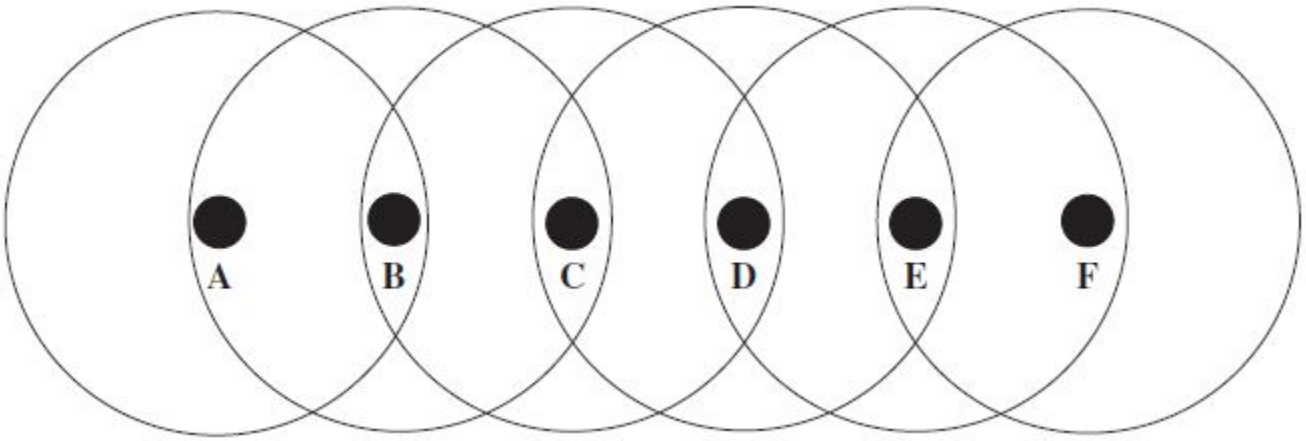

Figure 1: Hidden terminal problem

b Node C sends to node B and node E wants to send to node D. Is E allowed to do so and will it do so?

Node C is transmitting to node B. As node E wants to transmit to node D, it will sense the medium before doing so. However, since *node E is outside the range of communication of node C*, it will sense that the medium is free and **can begin transmission**.

c Node A sends to node B and node D sends to node C. Which other nodes are allowed to send at the same time?

As node A, node B, node C and node D are busy in communication, only node E and node F are left out. Therefore node E can transmit to node F and vice-versa node F can transmit to node E. However, as CSMA is being used, as node E starts to transmit, since node D is transmittig, it will assume that the channel is busy and will not transmit. Therefore, **only node F can transmit data to node E in the given scenario**.

d Node A sends to node B and node E sends to node F. Which other nodes are allowed to send at the same time?

In the given scenario, only node C and node D are left out. Therefore they can communicate with each other. However, as node D tries to transmit data, it will find the medium busy since node E is transmitting.Therefore, **only node C can transmit data to node D in this situation**.