CSE 4215 :: Lab 2
Multiple Access with Collision Avoidance

Issued April 9, 2009; Due April 23, 2009.

In this lab, you will simulate the operation of the Multiple Access with Collision Avoidance (MACA) protocol.

Consider a discrete-time implementation of the MACA protocol with the following features:

- Time is divided into discrete chunks with integer indices: t = 1, 2, 3, ...
- Control messages (RTS, CTS, ACK) occupy one unit of time.
- Data packets (DATA) occupy ten units of time.

For example, if nodes A and B are the only nodes in the network, and A wants to send a data message to B, the exchange of MACA messages would occur as follows:

Time	1	2	3	4	...	12	13
A	RTS (to B)		DATA (to B)	DATA (to B)	...	DATA (to B)	
B		CTS (to A)					ACK (to A)

In larger networks, we will make the following simplifying assumption: *control messages are never lost to collisions.* For example, if an RTS and a CTS are sent to node A in the same time slot, node A receives both control messages correctly.

Your simulation will have the following features:

- The network contains five nodes: A, B, C, D, and E, arranged in a ring:
    - A is in radio range of B and E
    - B is in radio range of A and C
    - C is in radio range of B and D
    - D is in radio range of C and E
    - E is in radio range of D and A

- At initialization, all nodes will attempt to send RTS to one of their neighbors. The destination of the RTS will be selected at random and with equal probability from the node's two neighbors.

- Once a node has successfully transmitted a DATA packet, the node will be "idle" for k time units. Once this idle time has expired, the node will attempt to send RTS again at its earliest permitted opportunity. The destination of the RTS will be selected at random and with equal probability from the

node's two neighbors. During the "idle" time, the node *will respond correctly to incoming MACA messages*; however, it will not initiate a data transmission. If the idle time expires while the node is doing something else (e.g., receiving a DATA packet), the RTS will be sent at the earliest opportunity, bearing in mind the MACA message priority (below).

- MACA messages have the following priority:
    1. ACK messages;
    2. DATA messages;
    3. CTS messages;
    4. RTS messages.
  For example, if at some time the MACA protocol requires a node to send both a DATA and a CTS message, it will send DATA first and then CTS. Messages cannot be transmitted simultaneously.

Acquire simulation results as follows:

- For k = 10, give the message traffic for your simulation, similarly to the above table, for the first 100 time instants.
- For various values of k, run simulations of your network until at least 200 DATA packets have been transmitted in total. Create two plots:
    o Plot the total number of DATA packets transmitted versus the duration of your simulation (this number is known as the *throughput*).
    o Plot throughput versus k.
  Note: your results should cover a fairly large range of k.
- Can you draw any conclusions from the above two plots? Also include any other simulation results that you might think are relevant.