Investigating MAC Protocols

Introduction

Objectives

At the end of this lab you should be able to:

- Explain the need for MAC protocols
- Use the simulator to investigate MAC protocols
- Describe main differences in MAC protocols
- Explain the methods devised to avoid collisions

Basic Theory

In a bus topology, packets of data sent by different nodes are broadcast to all other nodes on the bus. In a heavy traffic of packets it is likely that many packets will be destroyed due to multiple collisions. This is characteristic of multiple devices accessing a shared resource, the Ethernet transmission medium such as a UTP cable.

In order to avoid many collisions, various access protocols are developed. Two such protocols are Collision Avoidance (CA) and collision detection (CD). These are captured in "Carrier Sense Multiple Access with CA/CD (CSMA/CD or CSMA/CA)" access control mechanisms utilized by LAN networks.

Simulator Details

NOTE: It is important that you read this section BEFORE you start the exercises below.

When you start the simulator you'll see a single window (see Image 1 below) which represents a small LAN network segment composed of a LAN cable (black horizontal line) terminated at each end (blue boxes) and three nodes (PC0, PC1 and PC2) connected (black vertical lines) to the main cable.

At each node there is a drop-down list that can be used to select the destination node for packets from the node. To send a packet, click on a Send button.

As soon as a node sends out a packet, its colour changes to red thus indicating that it is waiting for an ACK (acknowledge) packet. Once an ACK packet arrives, its colour changes back to normal.

A node flashes red if it is temporarily prevented from sending out a data packet or an ACK packet.

In addition, each node displays the following information

- Collisions
- Retries
- Backoff

Can you guess what each of the above means?

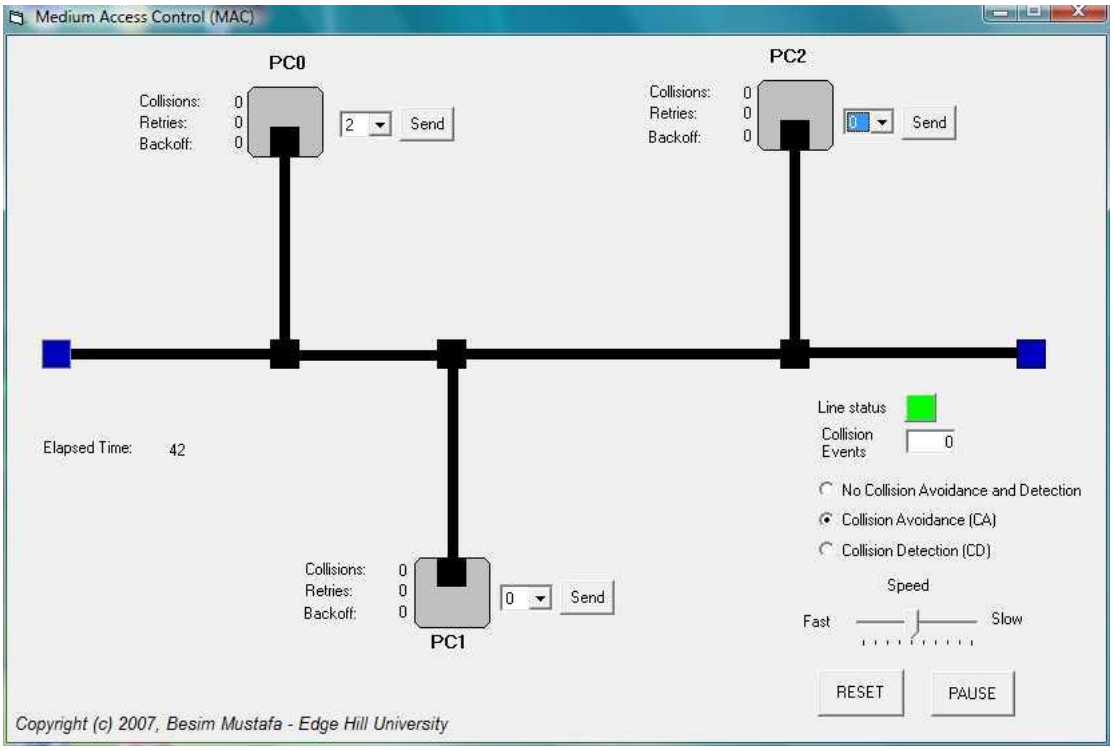

Image 1 – Simulator main window

This simulator has three modes of operation

- No Collision Avoidance and Detection

- Collision Avoidance (CA)
- Collision Detection (CD)

Can you explain the difference between CA and CD?

We'll operate the simulator in each of the above three modes in turn. You need to follow the instructions to the letter for maximum effect and correct operation.

To stop simulation, click on the **RESET** button; to pause the simulation, click on the **PAUSE** button and to restart simulation click on the **RESUME** button (same button as the **PAUSE** button). You can also select the speed of packets using the slider control.

A data packet is represented by a green box and an ACK packet is represented by a yellow box. When packets travel in opposite directions, as soon as they make contact, they are destroyed, i.e. collision has occurred.

Exercises

Start the Medium Access Control simulator (use the “CSMA Simulator” icon).

No MAC Protocol

1. Select **No Collision Avoidance and Detection** mode of operation.
2. Send a packet from PC0 to PC2 and a packet from PC2 to PC0 at the same time.
3. Observe what happens when the packets collide. Note that the nodes remain red in colour and no other packets are sent out, no matter how long you wait!
4. Explain what you observed. PC0 and PC2 are expecting ACK packets which never arrive. What can be done to make sure PC0 and PC2 receive ACK packets?
5. Why are the packets sent by PC0 to PC2 and those sent from PC2 to PC0 also sent to PC1 and the terminators (blue boxes) at the ends of the bus?
6. What happens to those packets that reach the terminators? Explain what the purpose of the terminator is and state what would happen if there were no terminators.
7. Click on the **RESET** button.

CA MAC Protocol

8. Select **Collision Avoidance** mode of operation.
9. Send a packet from PC0 to PC2. Wait until the packet starts travelling along the horizontal black line towards PC2, then send a packet from PC2 to PC0 as soon as possible.
10. Observe the behaviour of PC2. It is flashing red and no packet is sent until it receives the packet from PC0.

11. Repeat 9 above, but this time, do not wait for the packet from PC0 to travel on the horizontal line. Observe the result.
12. Explain the two different behaviours between 9 and 11.
13. Click on the **RESET** button.

CD MAC Protocol

14. Repeat 9 and 11 above. Observe the two behaviours. Pay attention to the value of the Backoff parameter. Why does the value of Backoff parameter count down and what happens when it reaches zero?
15. Observe the values of the displays Collisions and Retries as collisions take place and packets are retried.
16. How is this case different than the “CA MAC Protocol” mode?
17. Can you offer any explanation?
18. Explain the function of the Backoff parameter.
19. Why does the starting value of Backoff change each time as multiple collisions occur? What is the significance of these changes?
20. What would happen if all nodes had the same Backoff values?
21. Click on the **RESET** button.