Virginia Tech ■ ECE/CS 4570: Wireless Networks and Mobile Systems ■ Spring 2006

At-home Exercise 7 (E07)

Report Due: March 16, 2006 (at 4:00 PM)

Part I – Objectives

The objectives of this assignment are to:

- Analyze the effect of the virtual carrier sensing mechanism on IEEE 802.11b performance; and
- Study the effect of hidden nodes on ad hoc networks.

After completing the assignment, you should be able to:

- Suggest scenarios where the virtual carrier sensing mechanism (RTS/CTS signaling) will prove to be an effective addition to the carrier sense multiple access with collision avoidance (CSMA/CA) protocol.

Part II – At-home Laboratory Assignment

Consider the network configuration shown in Figure 1. (All figures appear at the end of this document.) An experiment was performed in which data was sent from both node A and node C to node B. *Iperf* was used to generate the traffic and Observer, a network sniffer that operates at the link layer and above, was used to capture the traffic.

The experiment was carried out for two different MAC layer conditions.

- In the first case, the virtual sensing mechanism was disabled and UDP data was transferred for 1 minute from each of nodes, A and C, to node B at a rate of 2 Mbps. The UDP datagram size was 1,470 bytes. A screen shot of the data captured by Observer is shown in Figure 2. Figure 2 provides a summary of the data exchanged by the two transmitter nodes (A and C) with the receiver node (B).
- For the second case, the virtual sensing mechanism was enabled and UDP data was transferred for 1 minute from the two transmitter nodes to the receiver. The IEEE 802.11b bandwidth for each of the two links was fixed at 2 Mbps and the UDP datagram length was set to 1470 bytes. A screen shot of the data captured by Observer is shown in Figure 3.

Note that the network configurations for the two cases were the same except for the RTS threshold setting. The physical configurations for the two cases were kept the same as much as possible.

Using this information, answer the following questions.

1. Based on the data in Figures 2 and 3, briefly explain the reason for the difference in the number of bytes observed at the MAC layer transmitted by node C to node B.
2. When the virtual sensing mechanism is turned on, why do we observe an increase in the number of bytes transmitted by node A?
3. Do you think it is justified, from the perspective of node A, to enable the virtual sensing mechanism for the network scenario considered here? Infer your answer from the screen shots provided.

Part III – Report

This report will cover both the in-class and take-home components of this week's topic. The report will be graded for both form and content. The report must be submitted in electronic form to the Dropbox on

the Blackboard site for this course. Adhere to the submission guidelines provided earlier in the semester. Each group must submit one report for the entire group.

Your report must answer each of the following questions in the order given.

Part I – In-class Experiments

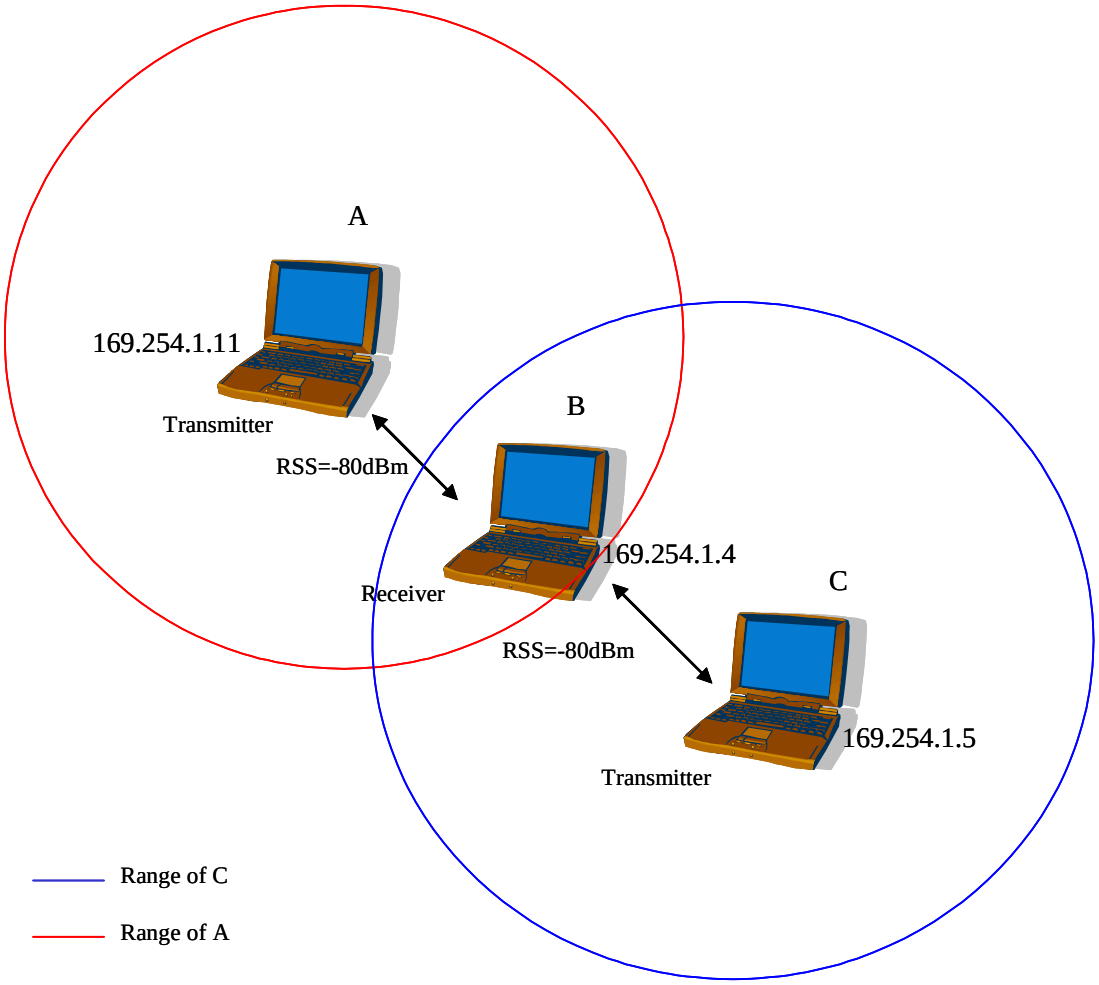
1. Include the three screen shots from the in-class laboratory, specifically: (i) the ping output at the receiver showing connectivity, (ii) *iperf* throughput with RTS/CTS disabled and a datagram length of 50 bytes, and (iii) *iperf* throughput with RTS/CTS enabled and a datagram length of 50 bytes.
2. From the in-class exercise, plot the throughput versus packet size with and without the virtual carrier sensing mechanism, as experienced by your node acting as a transmitter. Plot both curves on a single graph. Note that if your node was acting as the receiver (running the *iperf* server), plot the data observed at any one of the transmitter nodes and use this data to answer the related questions below.

Part II – At-home Assignment

1. Include the answers to the three questions in Part II of this at-home assignment.
2. Analyze the results of the RTS/CTS experiments conducted during the in-class laboratory to observe the effect of RTS/CTS on throughput.
   a) Do the throughput curves for the two scenarios intersect?
   b) For what datagram sizes is the throughput for your transmitter node with the RTS/CTS mechanism enabled more than the throughput obtained with the RTS/CTS mechanism disabled? For what datagram sizes is the through with RTS/CTS less than that obtained with RTS/CTS disabled? Give reasons for the observed behavior.
   c) Do you think that the virtual sensing mechanism should be enabled irrespective of the data payload size? Briefly explain your answer.

Part III – General Conclusions

This is the "free-form" portion of your report. Provide a summary of lessons learned in this laboratory, general observations on how each of the tools illustrated by the experiments can be used to configure and assess performance of the network, any unexpected results obtained, etc. Feel free to suggest improvements to the experiments.



Mapping between MAC Addresses and IP Addresses

Nodes	IP address	MAC address
Node A	169.254.1.11	xx:xx:xx:38:61:F1
Node B	169.254.1.4	xx:xx:xx:48:43:BC
Node C	169.254.1.5	xx:xx:xx:35:CA:F3

Figure 1. Network configuration for the experiment discussed in this document.

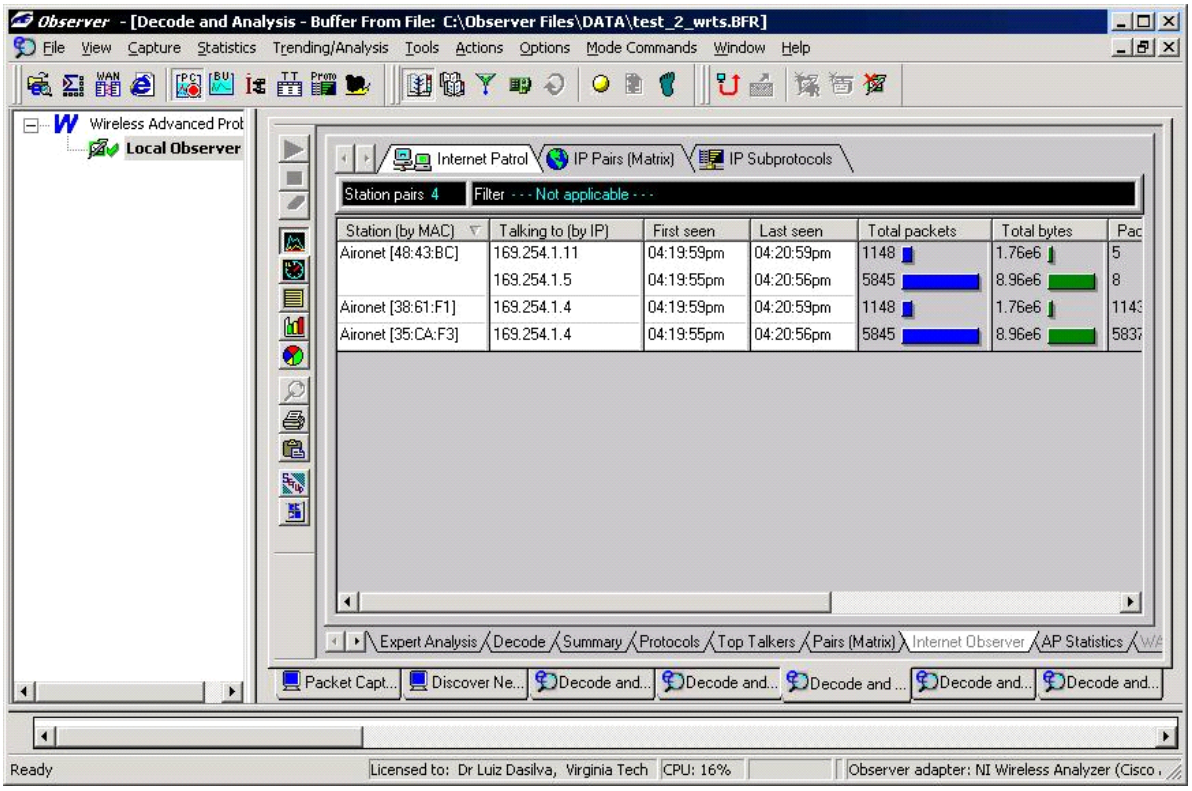


Figure 2. Data captured by Observer with the virtual sensing mechanism *disabled*.

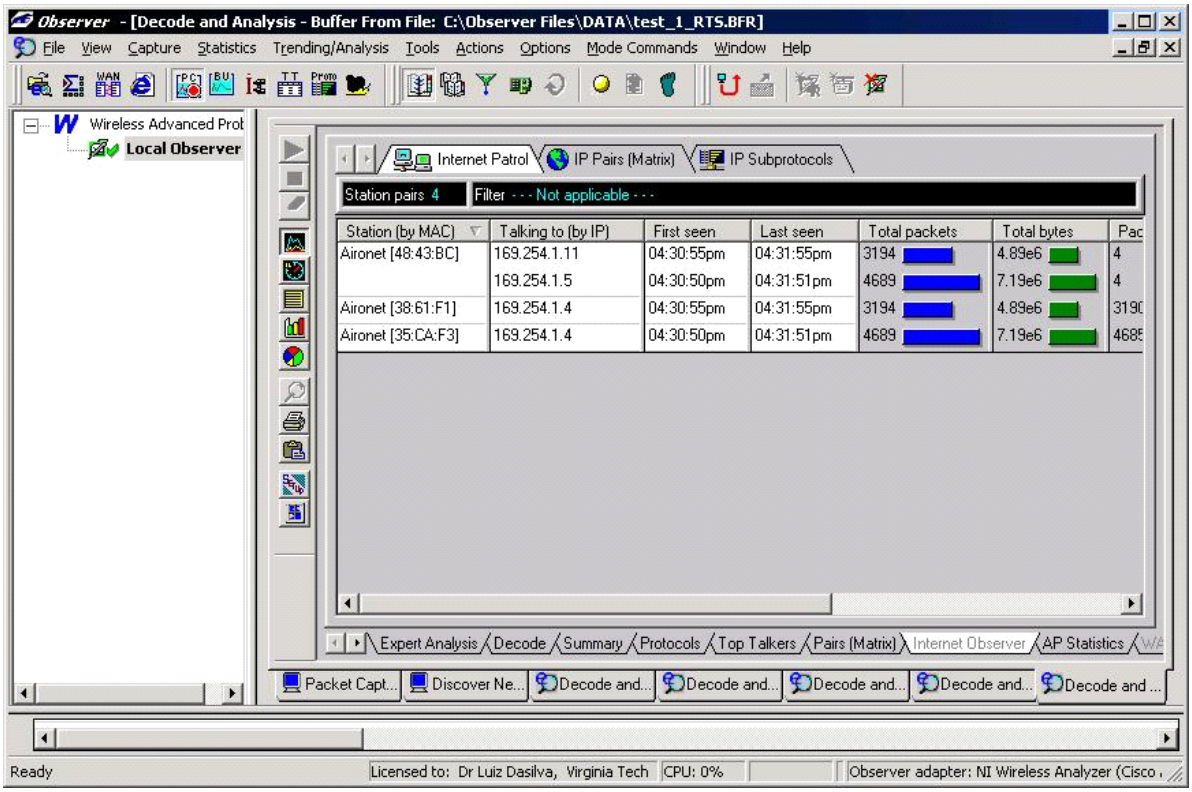


Figure 3. Data captured by Observer with the virtual sensing mechanism *enabled*.