ECE 578 Project1. DCF of 802.11 Draft1

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1 Introduction

1.1 Transmission Topology

In this project, our objective is to investigate the performance of various access protocols within a wireless environment, with a specific focus on two scenarios illustrated in Figure 1. Both scenarios will be evaluated against one another by examining the performance of Carrier-Sense Multiple Access with Collision Avoidance (CSMA/CA) and Carrier-Sense Multiple Access with Virtual Carrier Sensing (CSMA VCS) network protocols.

1.2 Responsibilities

The tasks among the team are split as follow: Both member participate in the programming and simulation, with Tianrui's idea of coding the problem as a state machine, and Jimmy addressing bugs and validating the event based simulation. After achieving a satisfactory level of simulation integrity, then the report was developed involving Tianrui initially creating the outline and rough draft. Subsequently, Jimmy conducted peer reviews, and finally, Tianrui and jimmy collaboratively analyzed the presented data.
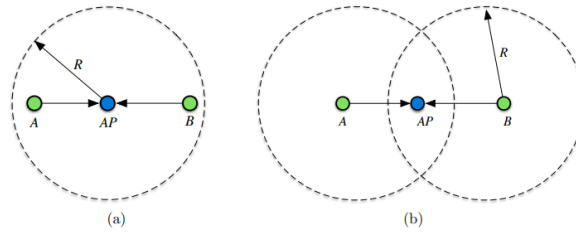

Figure 1: (a) The configuration for concurrent transmissions occurring in a shared collision domain, (b) the arrangement for concurrent transmissions when A and B function as hidden terminals.

2 Simulation and Development

All the programming is done in Python. In our simulation, we integrated the concept of a state machine, where both the stations and the access point transition through different states in response to specific events and scenarios outlined in the problem statement. The terminals then use the feedback received to determine their next state.

The simulation's parameters are detailed in the table 1. To calculate the data frame size in slots, $\big((1500 \text{ bytes} \times 8) / 10\text{Mpbs} \big) / 10 \ \mu s = 120$ slots.

3 Analysis

3.1 Throughput

The formulation used for our analysis of throughput is shown in equation 1.

Parameter	Value	Parameter	Value
Data frame size	1,500 bytes	ACK, RTS, CTS size	3 slots
Slot duration	10 µs	DIFS duration	4 slots
SIFS duration	1 slot	Bandwidth	10 Mbps
CW_0	8 slots	CW_{max}	512 slots
$\lambda_c = \lambda_A$	{100, 200, 300, 500, 800, 1000} frames/sec	Simulation time	10 sec

Table 1: Simulation parameters.

$$T = \frac{\text{Data frame size} \times 8 \times \text{successful transmission}}{\text{simulation time}} \tag{1}$$

3.2 Collisions

Collisions are detected by assessing whether the node states are concurrently in the 'transmitting' state.

3.3 Fairness Index

The Fairness Index is defined as the ratio of one node's transmission time to another node's transmission time, and it varies with λ. This index serves as a measure of fairness for both nodes, with a value closer to one indicating greater fairness between them.