CS356R (Spring 2026) – Homework 2 solutions

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Problems 1–3 Timing Diagrams

The detailed timing diagrams for Problems 1, 2, and 3 are provided on the following page.

Problem 4: Effect of Removing NAV While Keeping Physical Carrier Sensing

In IEEE 802.11 DCF, the Network Allocation Vector (NAV) implements *virtual carrier sensing*. When a station hears an RTS, CTS, or DATA frame containing a duration field, it sets a timer and defers transmission for the entire reserved period, even if it cannot physically sense all subsequent frames.

If NAV is removed while keeping physical carrier sensing (CCA), stations defer only when they detect energy on the channel. This significantly affects network behavior, especially in hidden-terminal scenarios.

1. Loss of Hidden-Terminal Protection In a hidden-terminal topology, nodes A and B cannot sense each other but both can transmit to C. With RTS/CTS and NAV enabled, if A successfully transmits an RTS and C replies with CTS, both A and B hear the CTS and set their NAV timers. This prevents B from transmitting during A's DATA transmission, thereby protecting the exchange.

Without NAV, even if B hears the CTS, it does not maintain a reservation timer. Once the channel appears idle to B, it may begin transmitting during A's DATA transmission, resulting in a collision at node C. Therefore, removing NAV largely eliminates the hidden-terminal protection provided by RTS/CTS.

2. Increased Collisions Physical carrier sensing relies on detecting signal energy above a threshold. Due to path loss, fading, or threshold limitations, a station may fail to detect ongoing transmissions reliably. Without NAV enforcing a reserved silent period, stations may incorrectly assume the channel is idle and transmit during an active DATA–ACK exchange, increasing collision probability.

3. Reduced Throughput and Fairness NAV improves efficiency by preventing unnecessary retransmissions caused by hidden terminals. Without NAV, collisions occur more frequently, leading to additional backoff stages and retransmissions. This reduces overall throughput and may create unfair channel access among nodes.

Conclusion Removing NAV while retaining physical carrier sensing degrades the effectiveness of RTS/CTS and reintroduces hidden-terminal collisions. Physical carrier sensing alone is insufficient to guarantee protection of ongoing transmissions.

Hw2

Sunday, February 22, 2026 3:23 PM

Given Backoff counters

A: 6, 3, 5, 6, 4

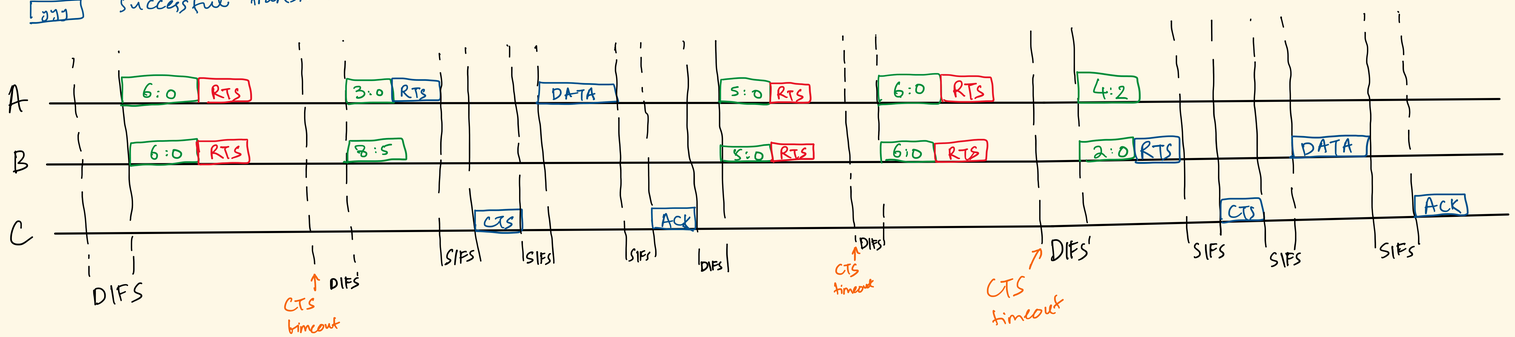
B: 6, 8, 6, 2, 7

m:n Backoff counter reduced from m to n

xRTSx Collided frames

DATA successful transmission

Problem #01



Problem #02

→ Hidden terminals

→ No RTS/CTS (Data-ACK only)

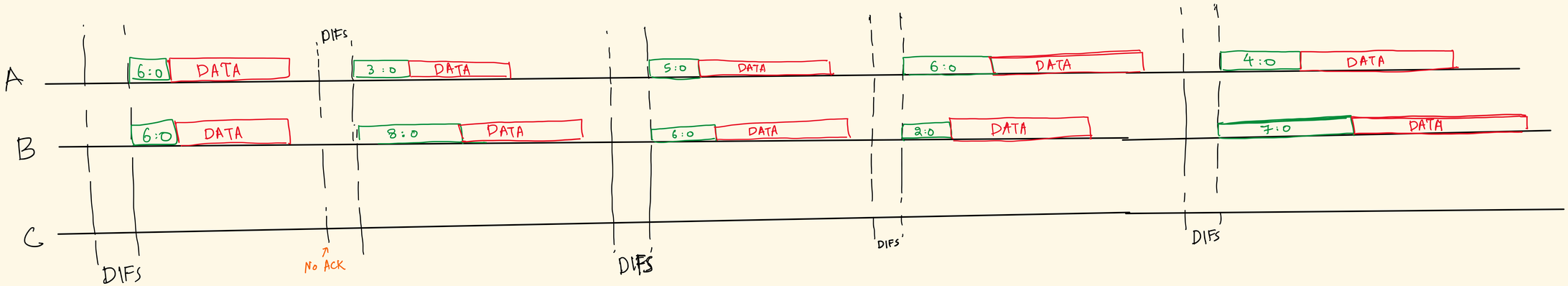
Important Rule:

A & B can't sense each other; so

→ No freezing

→ Collisions happens at C

→ Collision - no ACK



Problem #03

Hidden Terminals

RTS/CTS enabled