A wireless network using a base station

A wireless ad-hoc or mesh network
Access points connected to a distribution network in 802.11

The hidden node problem: A and C can’t hear each other, both send to B. Their signals collide at B.
CSMA/CA

- If a station (wireless host or access point) has a frame to send, it senses the channel
  - If channel is idle, start to transmit
  - If channel is busy, wait for the channel to become idle. Once the channel is idle, the station enters a contention phase
- Contention phase
  - The station chooses a random backoff time $t$ within a contention window and starts counting down its backoff timer.
  - If $t$ is over and the channel is still idle, the station can transmit
  - As soon as the station senses the channel is busy, it stops its backoff timer, waits for the medium to be idle and starts the timer again. When the timer counts down to 0, the station transmits
  - Contention window doubles each time a collision occurs
- Error recovery
  - All unicast frames must be acknowledged.
  - Sender retransmits the frame if no ACK is returned.

RTS/CTS

- First exchange control frames before transmitting data
  - Sender sends a Request to Send (RTS) control frame. RTS contains the duration of the whole data transmission (data & ACK).
  - Receiver answers with a Clear to Send (CTS) frame. CTS echoes the duration field.
- If sender sees CTS, transmits data
- If other nodes see CTS, will idle for ‘duration’ period to avoid collision at receiver
- If other nodes see RTS but not CTS, free to send
**Hidden Node Problem**

- A and C can’t hear each other, both send to B
- RTS/CTS can help
  - Both A and C would send RTS
  - B only responds to one RTS (say, A’s RTS)
  - C finds that CTS doesn’t match its RTS, won’t send to B

**Exposed Node Problem**

- B sending to A, C wants to send to D
- As C receives B’s packets, carrier sense would prevent it from sending to D, even though C’s transmission to D will not interfere with A’s ability to receive from B
- RTS/CTS can help
  - C hears RTS from B, but not CTS from A
  - C knows its transmission will not interfere with A
  - C is safe to transmit to D