Now, it’s your turn

...to design a Random Access Protocol

instructions given in class
You’re a group of students in a pitch black room who wants to discuss pairwise.

Each conversation is different and quite bursty exchanges followed by random silences.

Whenever 2 people speak at the same time, the entire communication is lost.

Sounds propagate slowly, at 1 m per second, defies the law of physics!
Design an access protocol which does not require synchronization or feedback between any you

3 questions

When do you speak?

How do you detect *any* possible collisions?
think worst-case

What do you do when you detect a collision?
what could go wrong?

You have ~10 minutes
In practice, multiple access control is provided using Carrier Sense Multiple Access (CSMA)

carrier-sense  

listen before speaking, don’t interrupt
carrier-sense  

*listen* before speaking, don’t interrupt

Is that enough to eliminate collisions?
Is that enough to eliminate collisions?  

Nope
Two nodes may not hear each other’s
before sending because of propagation delay
The problem is that collisions waste a full transmission slot
CMSA/CD Collision Detection
aims at detecting collisions within a short time

carrier-sense

listen before speaking, don’t interrupt

collision detection

stop if someone else starts talking
ensure everyone is aware of the collision
B and D can tell that collision occurred:

- abort the transmission
- jam the link
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**When do B and C retry?**
To avoid synchronization problems, hosts wait a random amount of time before trying again.

carrier-sense

*listen* before speaking, don’t interrupt

collision detection

*stop* if someone else starts talking
ensure everyone is aware of the collision

randomness

don’t talk again right away
CSMA/CD worked well in wired networks, not in wireless networks

- **wired networks**: compare transmitted with received signals
- **wireless networks**: reception shuts off while transmitting
  - broadcast is not perfect (limited range)
  - local detection only
  - leads to use of **Collision Avoidance** instead of **Collision Detection**
You are now in a much bigger room

- Person X
- Person A
- Person Y
- Person B
You are now in a much bigger room, so big you cannot even hear each other.
Luckily, everyone can hear and speak to a middle man sitting at the center of the room.
The middle man then relays the information to the actual destination.
Whenever two people speak at the same time to the relay, or when the relay is speaking, communication is lost.
Because of limited range, not all Wireless hosts necessarily see each other

Hidden Terminal Problem

A and C can’t see each other, both send to B
Exposed Terminal Problem

C wants to send to D, listens to the channel, and falsely assumes that it cannot
To cope with these challenges, CSMA/CA relies on extra control messages and ACKs.

<table>
<thead>
<tr>
<th>Control Messages</th>
<th>Acknowledgments</th>
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<tbody>
<tr>
<td>Request To Send (RTS)</td>
<td>Confirming correct reception</td>
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<tr>
<td>A and C would ask for right to transmit</td>
<td>if no ACK, sender assumes collision</td>
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<tr>
<td>Clear To Send (CTS)</td>
<td></td>
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<tr>
<td>B would only give it to one of them</td>
<td></td>
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</table>

More details in “Mobile Communications: Technology and QoS”