

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?

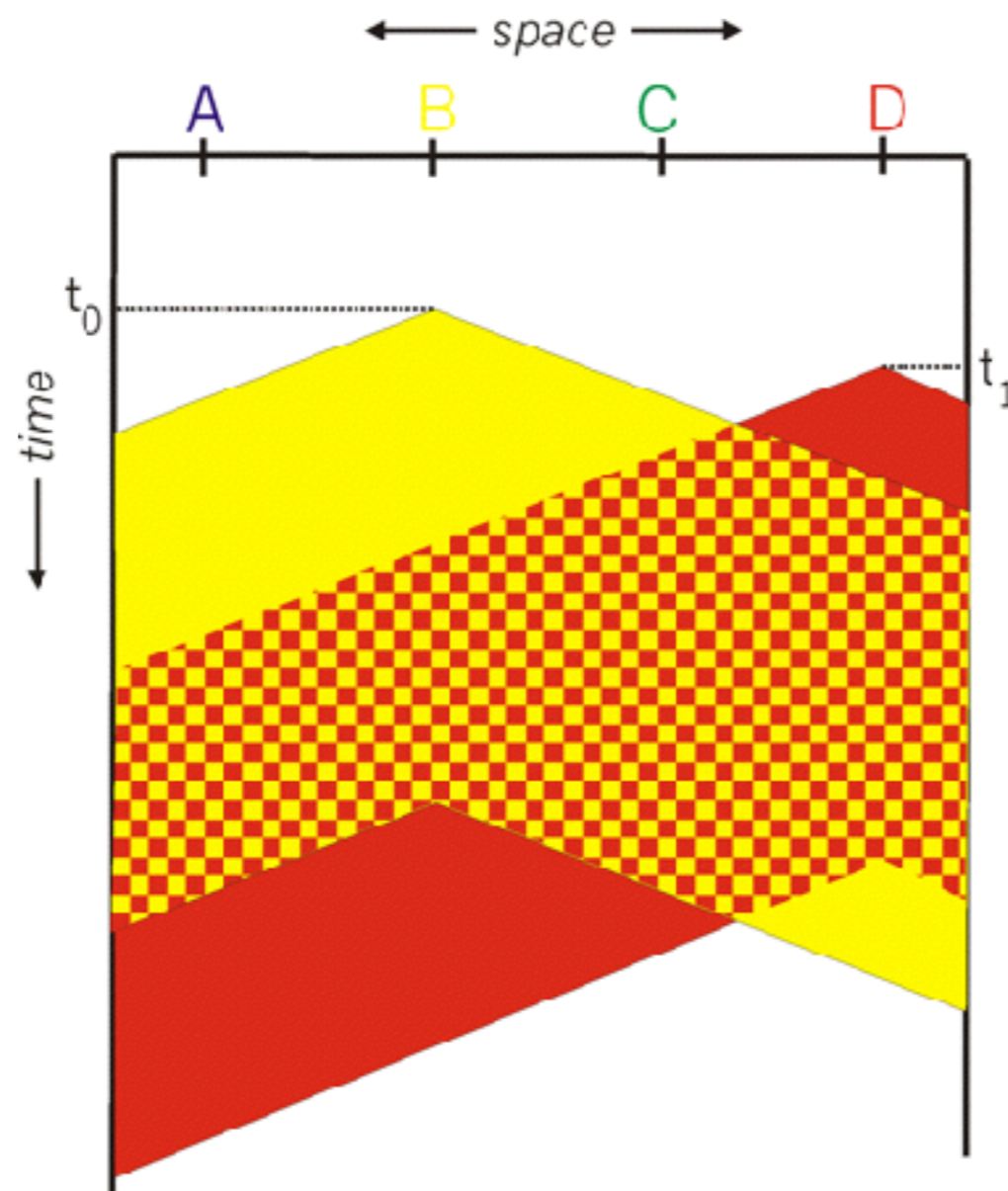
carrier-sense

listen before speaking, don't interrupt

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

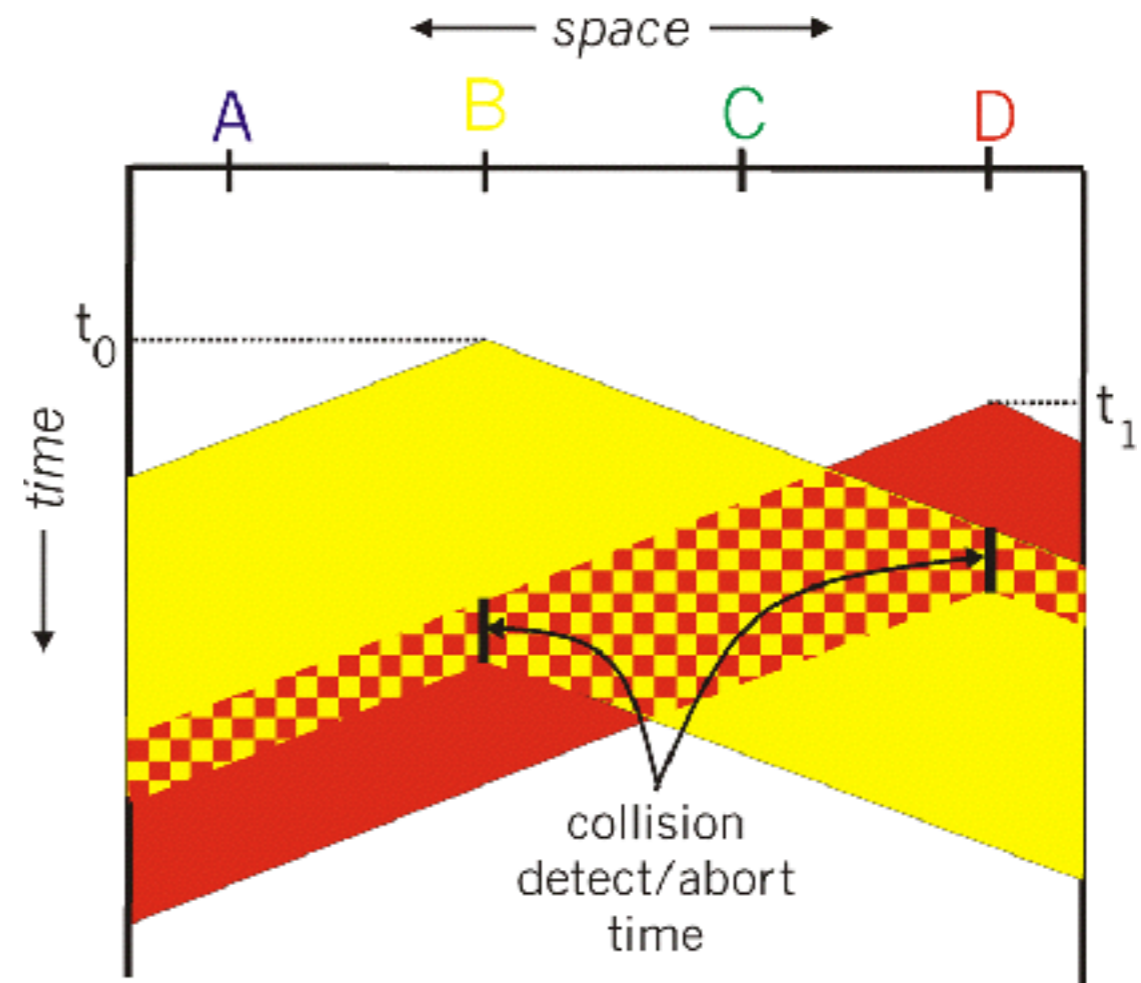
listen before speaking, don't interrupt

collision detection

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

B and D can tell that collision occurred:

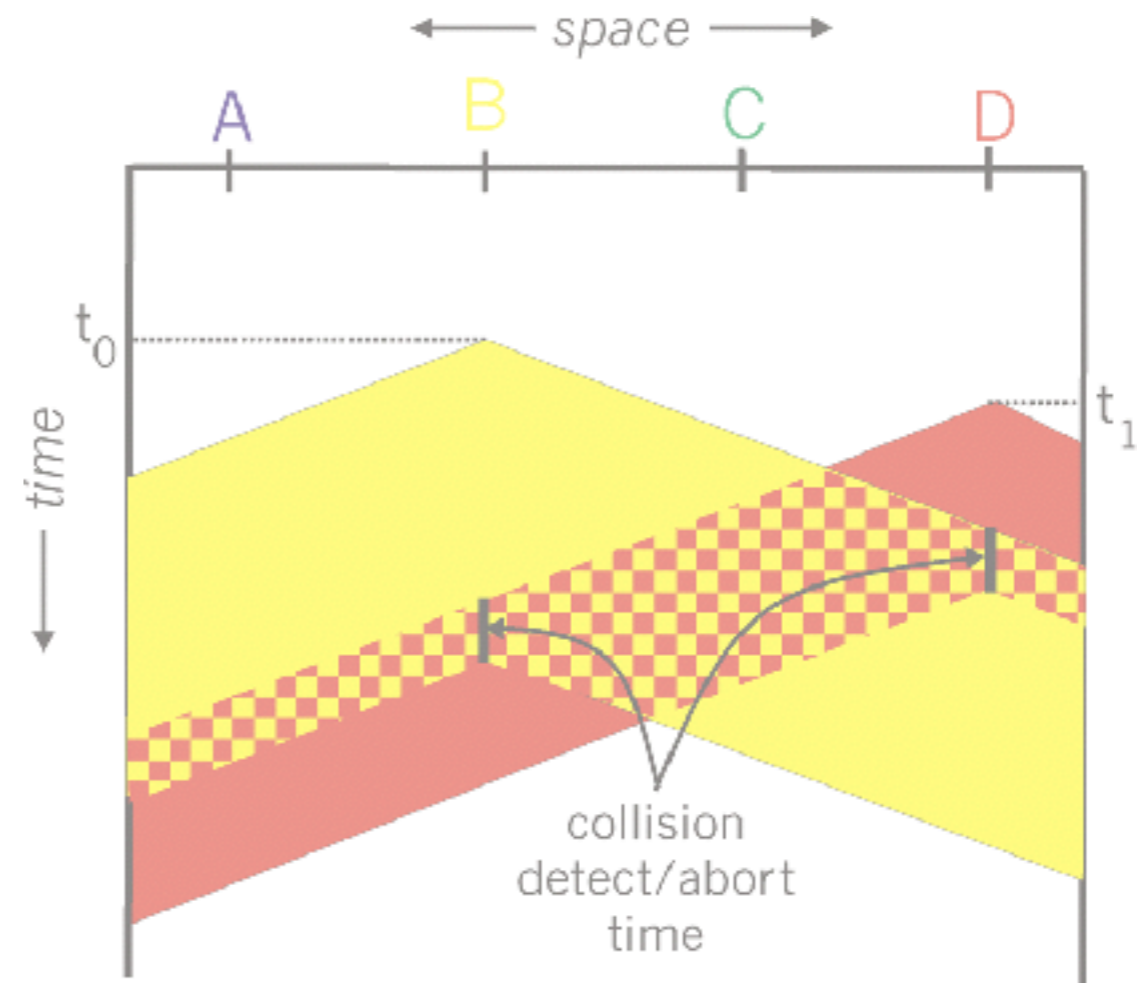
- abort the transmission
- jam the link



B and D can tell that collision occurred:

- abort the transmission
- jam the link

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

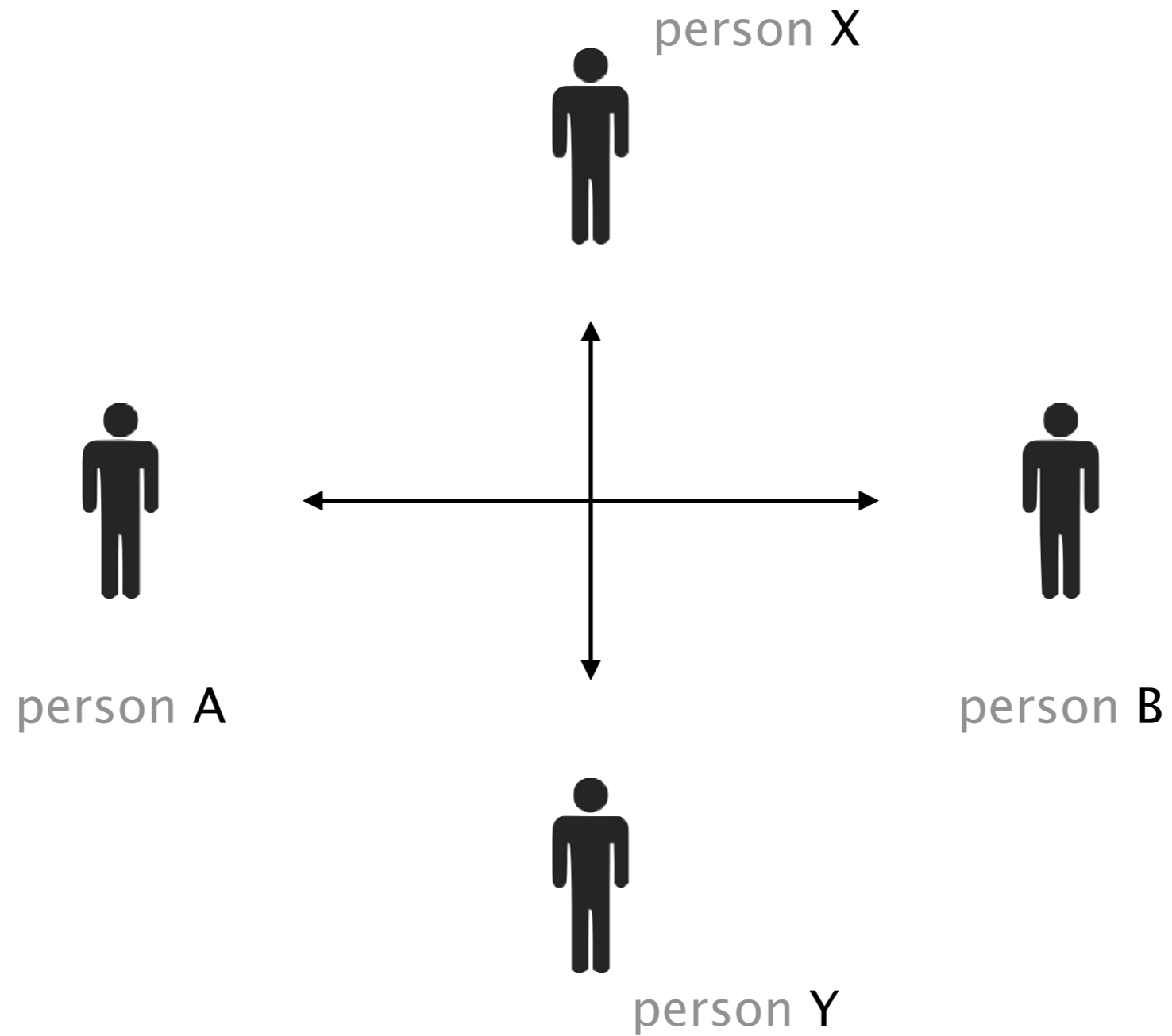
broadcast is not perfect (limited range)

local detection only

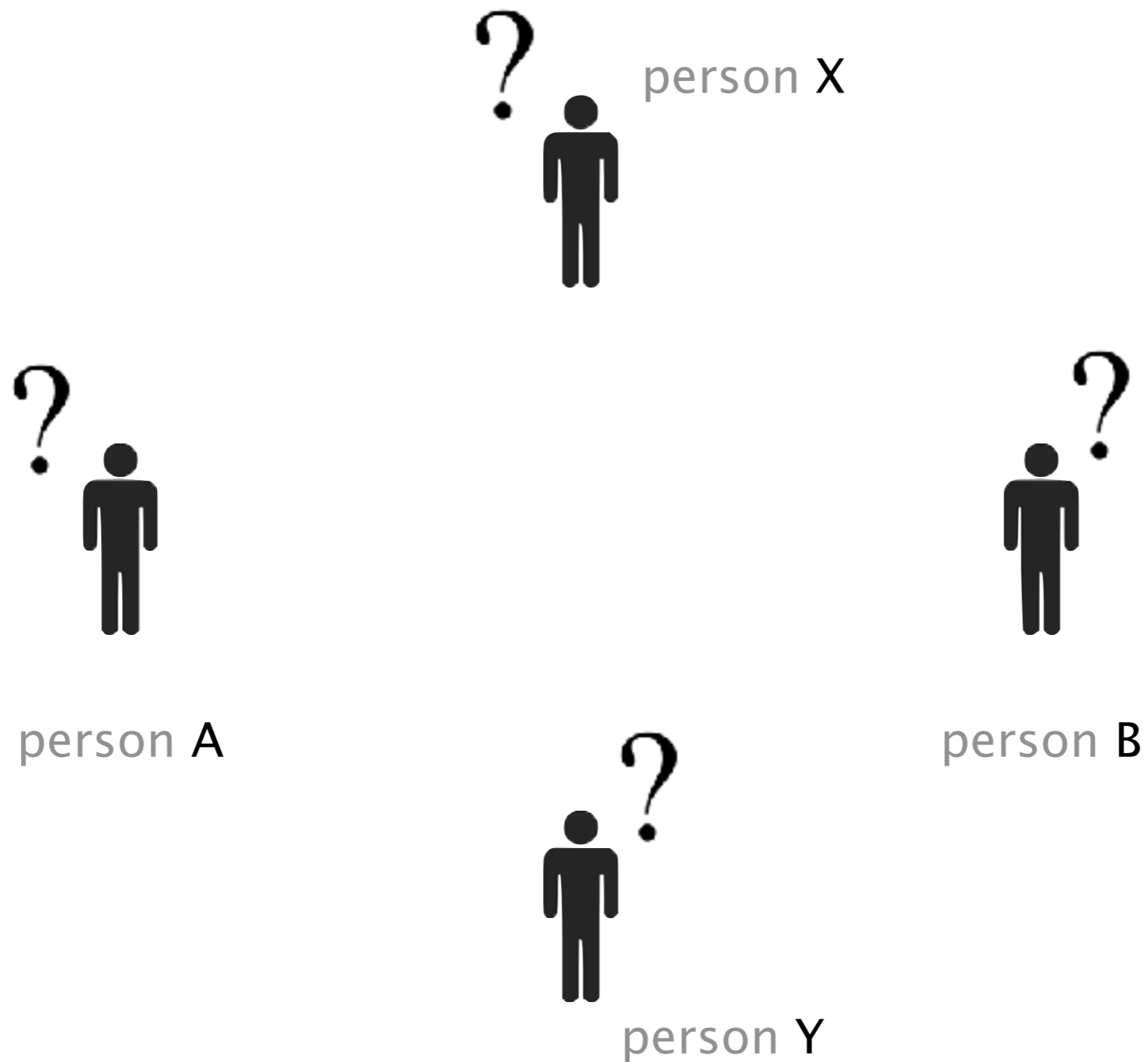
leads to use of **Collision Avoidance**

instead of Collision Detection

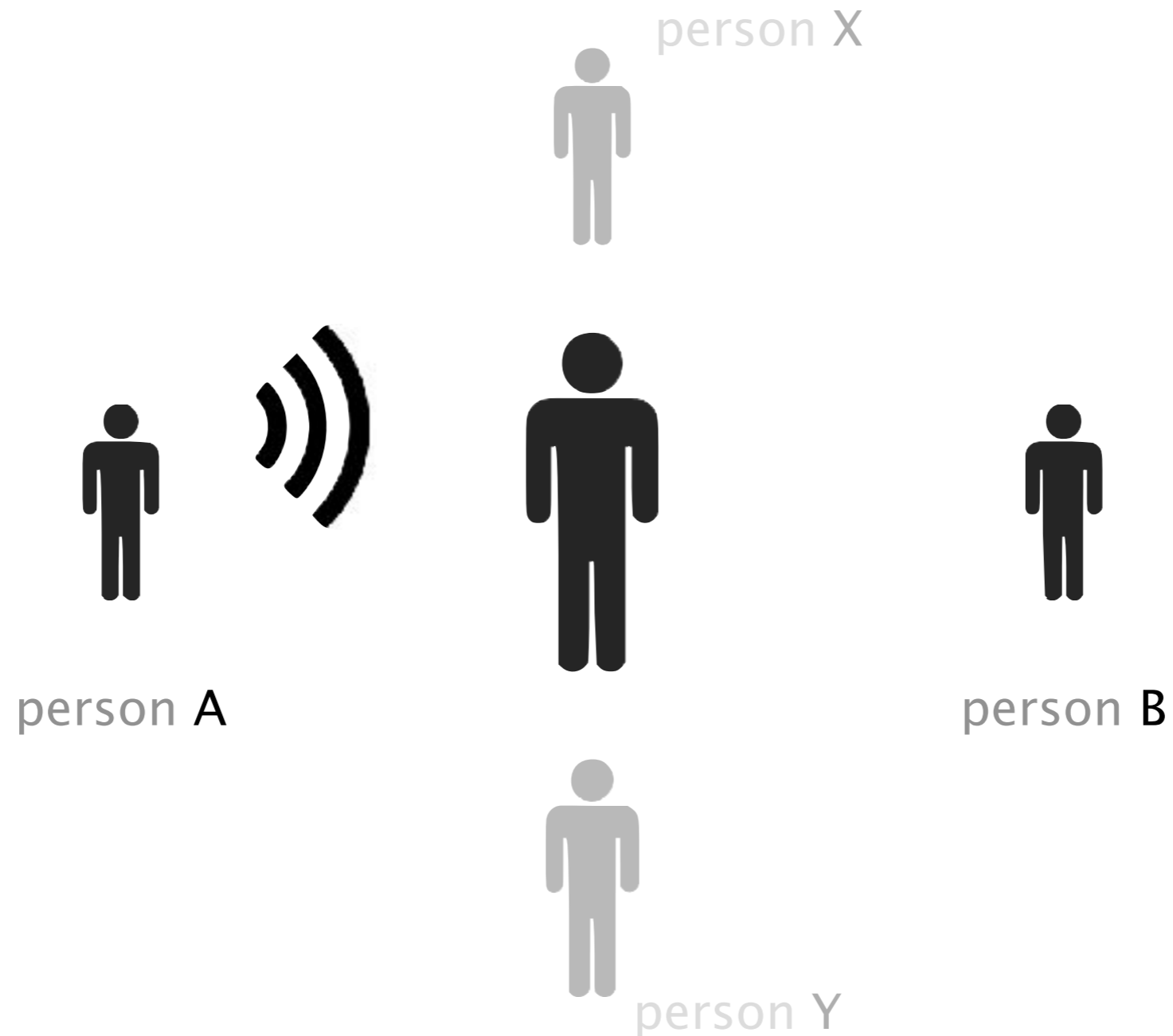
You are now in **a much bigger room**



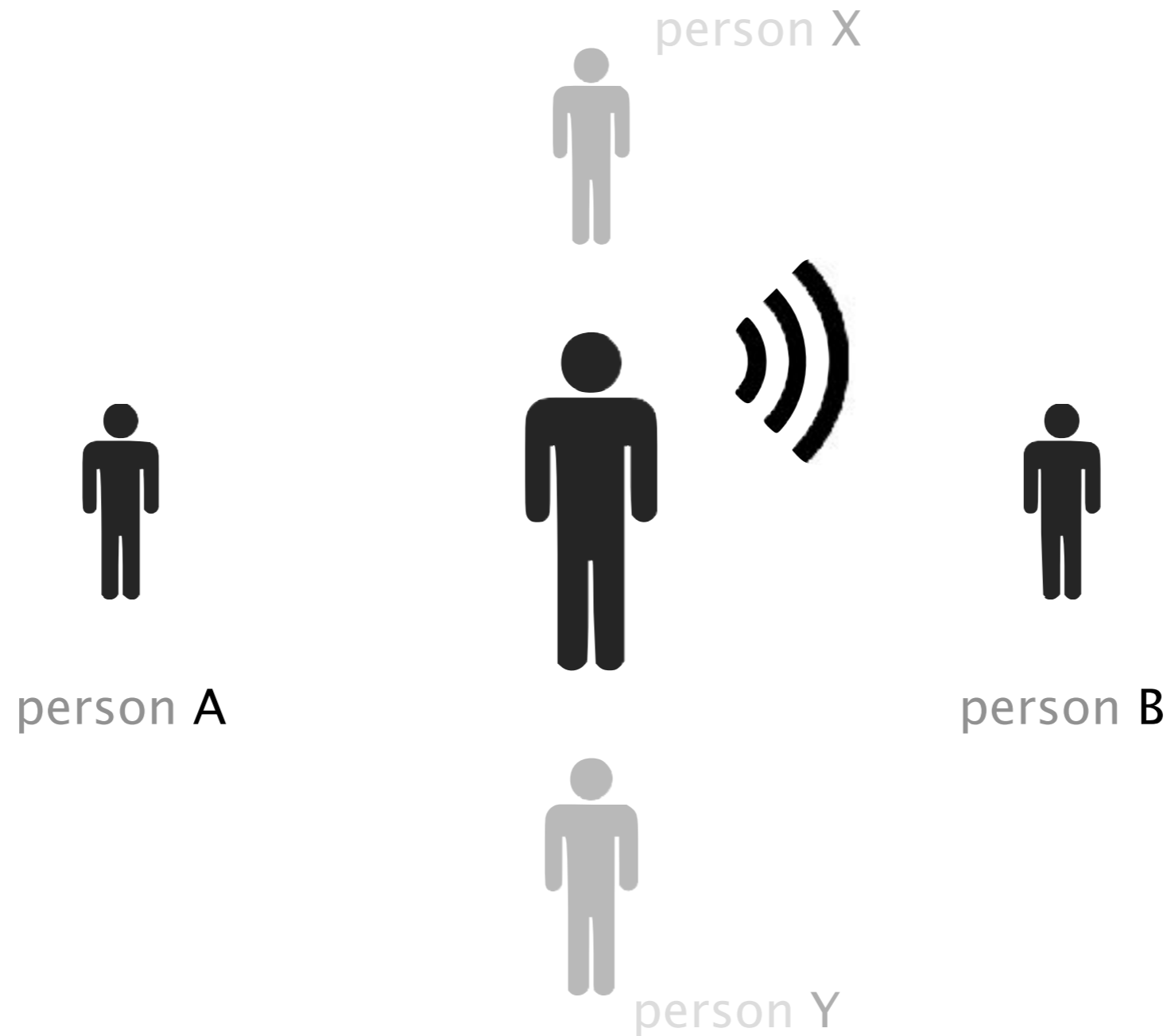
You are now in a much bigger room,
so big you cannot even hear each other



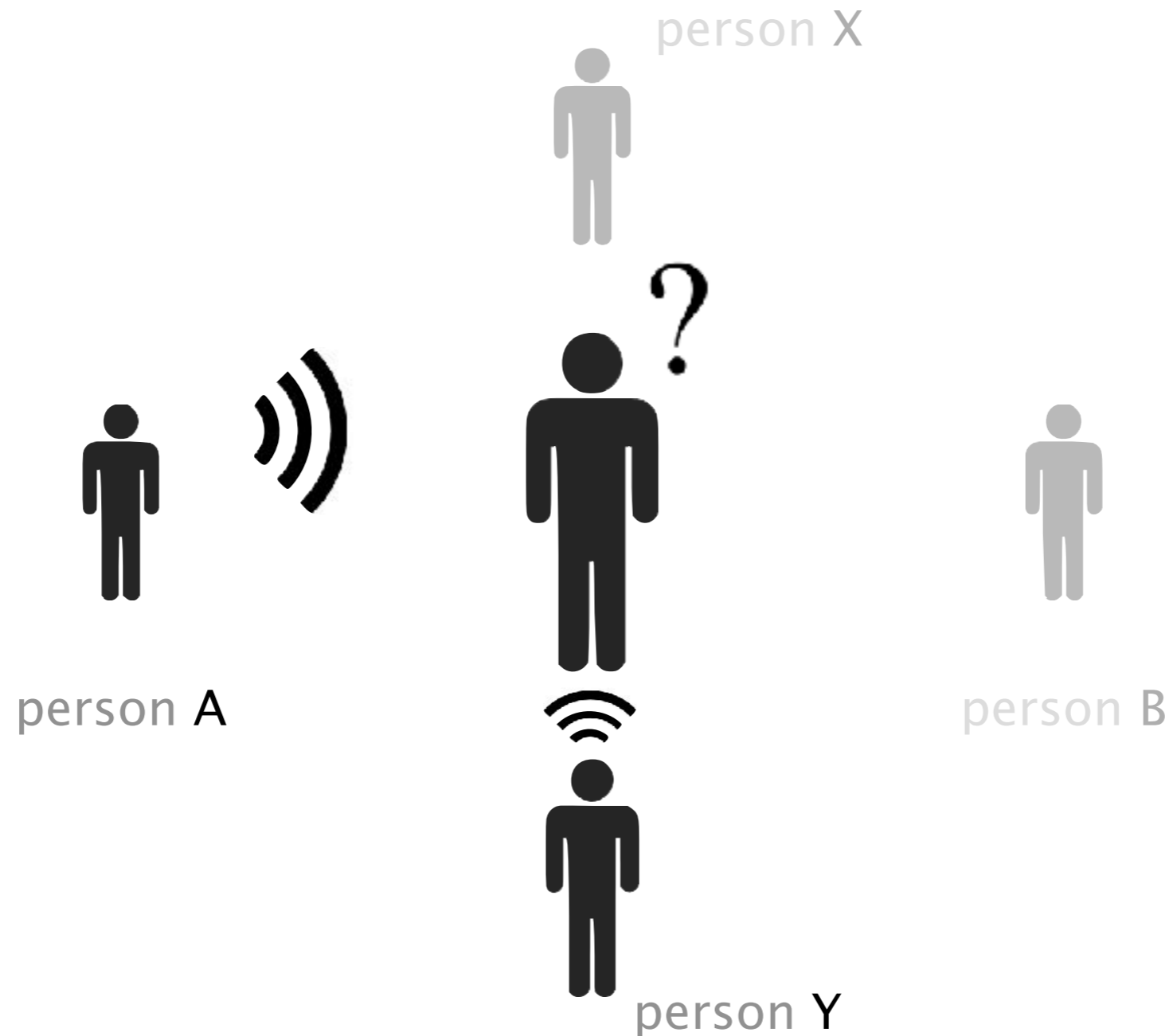
Luckily, everyone can hear and speak to a middle man sitting at the center of the room



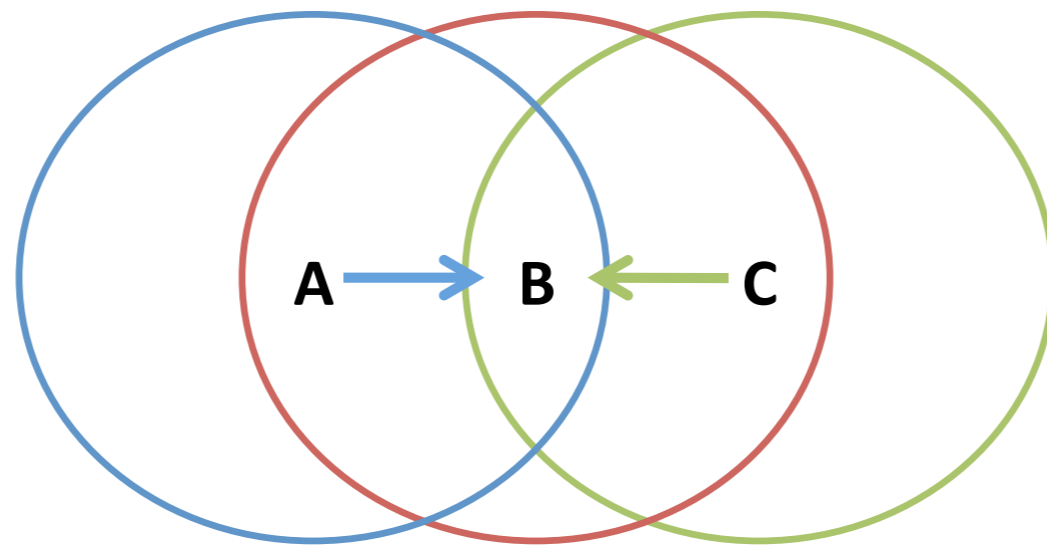
The middle man then relays the information to the actual destination



Whenever two people speak at the same time to the relay, or when the relay is speaking, communication is lost

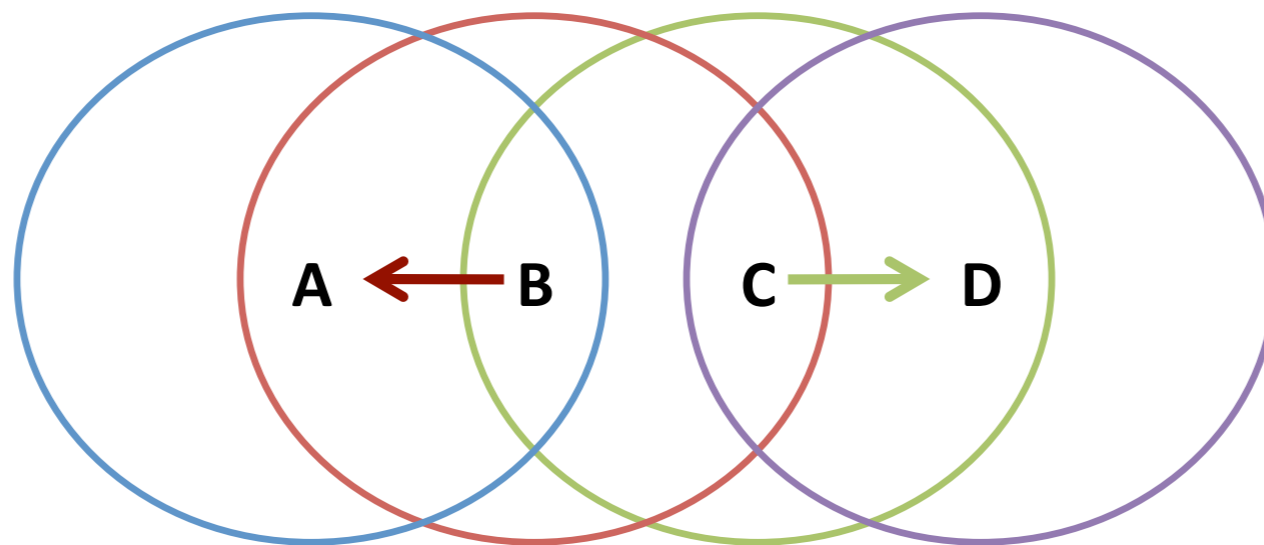


Because of limited range, not all Wireless hosts necessarily see each other



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

control messages

Request To Send (RTS)

A and C would ask for right to transmit

Clear To Send (CTS)

B would only give it to one of them

acknowledgments

confirming correct reception

if no ACK, sender assumes collision

More details in "Mobile Communications: Technology and QoS"