CS 168 Summer 2025

Wireless and Cellular

Discussion 13

1 True or False

1.1 Wireless is a fundamentally shared medium.

True: The wireless medium is a shared physical space instead of wired infrastructure.

1.2 The path loss of a wireless transmission is always the same in all directions.

False: Obstacles and reflections mean that the reality of wireless transmission is messy and non-uniform.

1.3 In cellular networks, the nearest tower to the user configures the specific routers to establish a path from the user to the Internet.

False: It is the job of the mobility manager, not the tower, to establish a path from the user to the rest of the internet.

1.4 When picking a tower to configure with, the user picks the tower (belonging to its operator) that is closest to the user in terms of distance.

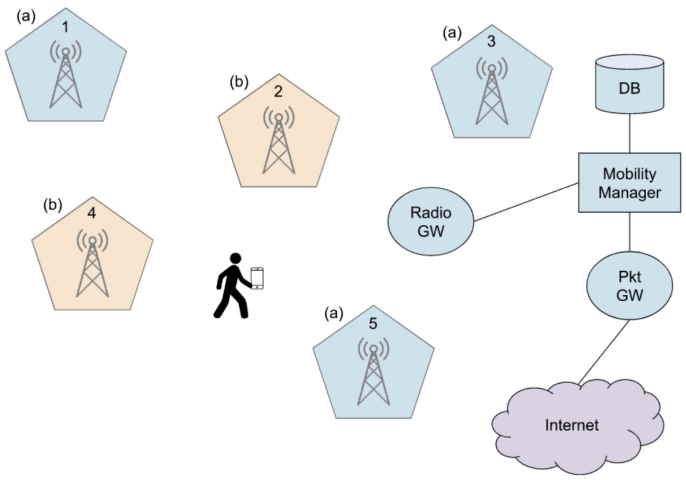
False: The user measures the signal strength to different towers, and picks the tower (belonging to its operator) with the best signal, not the least distance.

1.5 When towers periodically broadcast hello messages in order to be discovered, they include their network operator in these broadcast messages.

True: The reason they do this is so that only users who registered with the same network provider can connect to the tower.

2 Cellular

In the following cellular architecture, the user is registered with the cellular operator (a) shown in blue and labeled with (a). As the user moves around the area, they discover and transfer data using different cellular towers.



The user device is registered with operator (a), and gets the following beacons from the different towers with different received signal strength indicators (RSSI).

Tower	RSSI	Operator
1	−75dBm	(a)
2	−23dBm	(b)
3	−84dBm	(a)
4	−32dBm	(b)
5	−42dBm	(a)

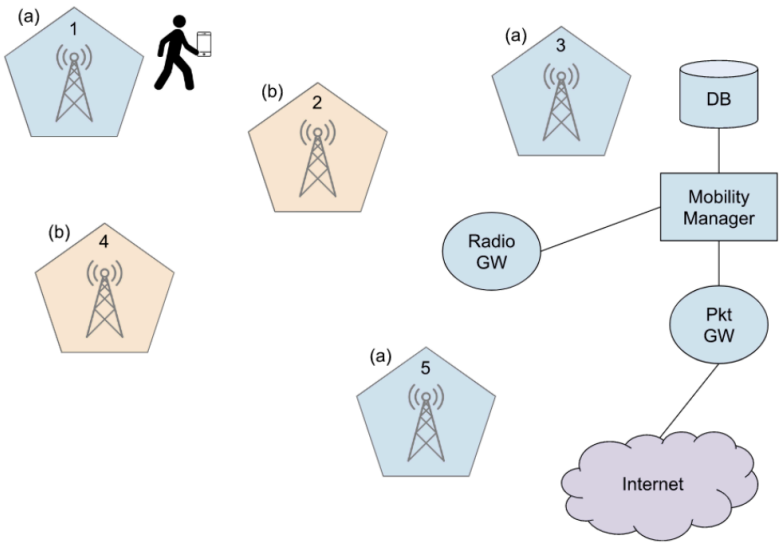
2.1 Which tower should the user device connect to?

The user should connect to the tower with the highest signal strength that is in the administrative domain that they have signed up for. In this case, tower 5 has the highest dBm for operator (a).

2.2 What entity in the cellular core processes the attach request from the user device?

The mobility manager processes the attach request by checking to make sure the user exists in the database, and providing authentication.

Now the user moves as shown below and a handoff to tower 1 must occur.



2.3 Who participates in the handoff? Select all that apply.

- ■ User Device
- ■ Tower 1
- □ Tower 4
- □ Packet Gateway
- ■ Old Tower (from part 1)
- ■ Mobility Manager

The user device itself, Tower 1 (new tower), the Old Tower (from part 1), and the mobility manager are all involved in the handoff.

2.4 Who initiates the handoff?

- ○ User Device
- ○ Tower 1
- ○ Tower 4
- ○ Packet Gateway
- ● Old Tower (from part 1)
- ○ Mobility Manager

The old tower initiates handoff.

3 Wireless

Consider the following hosts attempting to talk with each other using the Multiple Access Collision Avoidance (MACA) protocol from class. You may assume that when a host transmits a message, the message travels radially outward from that host at a uniform velocity.

Notably, if Host D transmits a message, then after one second, both Host C and Host E hear the message, and after two seconds, both Host B and Host F hear the message, and so on. All hosts are equidistant from each other.

A B C D E F G H I

Suppose after not hearing any messages being transmitted for a while, Host E wants to start the process for transmitting a message to Host G at time $t = 0$.

3.1 What is the first thing that Host E transmits, and why does this first step help reduce collisions?

The first thing Host E will do is transmit a Request to Send (RTS) packet that contains the length of the data it wants to send to Host G. This is to ensure that other hosts near Host E's range won't send anything, as every host that hears this packet will wait for one time slot before sending out their own packets.

3.2 How does this first step differ from what would happen through the Carrier Sense Multiple Access (CSMA) approach?

Since Host E waited for a while already, it would then immediately transmit its data to Host G (in reality in all directions, but meant for Host G). CSMA does not use any RTS or CTS packets, but instead automatically transmits data after waiting for some time to see if any other hosts are transmitting data.

Suppose Host G has received Host E's message from the "first step" of the previous part.

3.3 What packet does Host G now transmit to Host E, and what is the significance of this packet?

Host G now transmits a Clear To Send (CTS) packet that contains the length of the data Host E wants to transmit to Host G. This packet, once it reaches Host E, ensures Host E that it is clear to transmit its data to Host G, but it also ensures that everybody else in range of the receiver stays quiet during this time, so as to avoid collisions at the receiver.

3.4 Suppose Host A wants to transmit data to Host H at the same time that Host G receives E's "first step" message. By MACA rules, is Host A able to do this?

Yes, because Host G will receive Host E's RTS packet at time $t = 2$. At that point, Host A would not have heard Host E's RTS packet (since Host A is further away from Host E than Host G is to Host E). Therefore, in Host A's perspective, it is free to transmit an RTS packet to H.

3.5 Suppose Host E has now received the packet from Host G. Why can Host E now transmit the data and be assured that collisions at Host G are unlikely to occur?

Host E can now transmit the data, and the CTS message from Host G now ensures that all the hosts in Host G's close range, like Hosts H, I, and F, will be quiet while Host E now transmits its data to Host G.