
Wireless

— CS 168 – Spring 2024 – Discussion 13 —

Agenda

- Wireless Overview:
 - What is it?
 - What is different about wireless?
- Medium Access Control
 - CSMA
 - RTS/CTS
 - MACA/MACAW
- WiFi:
 - Architecture
- Cellular:
 - Architecture
 - Actions (Discovery, Attachment, Handover, Roaming)

Wireless Overview!

What is wireless communication?

- Transmit information without contact (e.g. with EM waves)



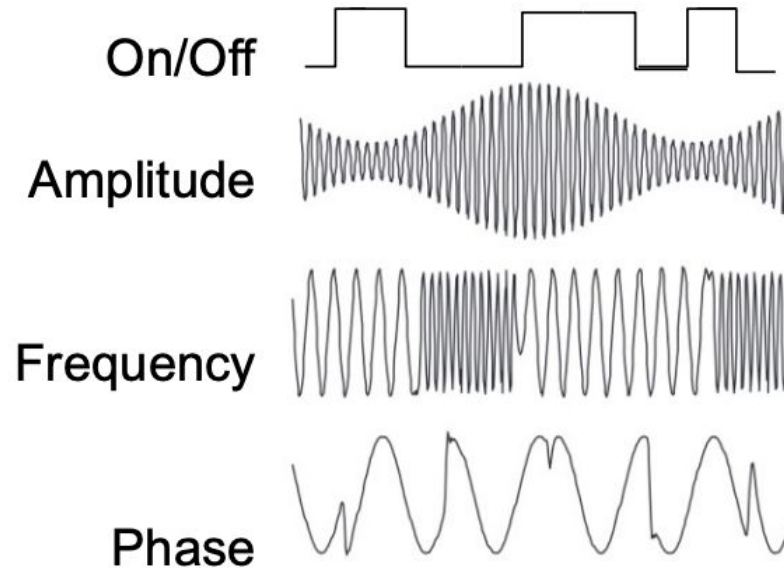
How is wireless different from wired?

Wireless ...

- is a fundamentally shared medium
- signals attenuate significantly with distance
- environments can change rapidly
- packet collisions are hard to detect

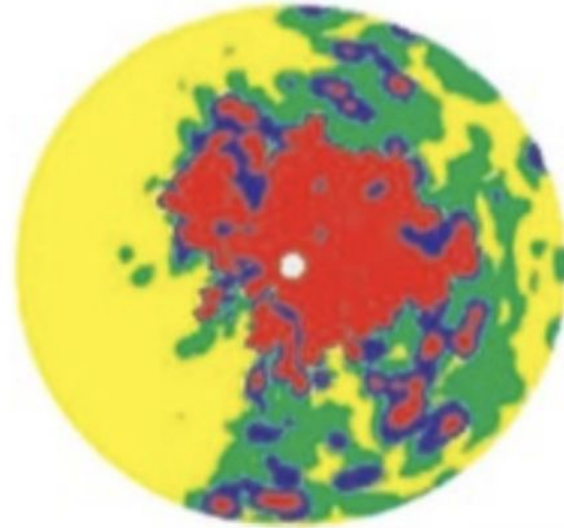
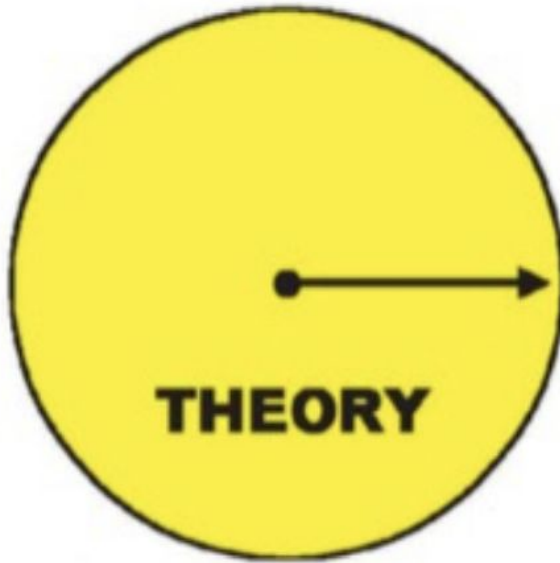
How is data encoded?

Physical Layer Modulation: Physical variations in signals map to digital values (i.e. 1 or 0)



The wireless medium is messy

Details out of scope!! Check out EE117, EE 121, EE122



Medium Access Control

How to share the same transmission technology?

Key problem: wireless collisions are often unexpected (highly mobile, dynamic environment) and hard to detect (failure is the only indication)

How do we deal with a lack of reliability in networks? Ideas?



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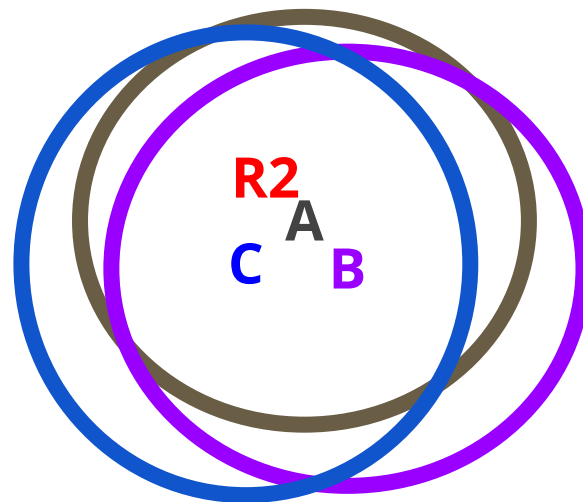
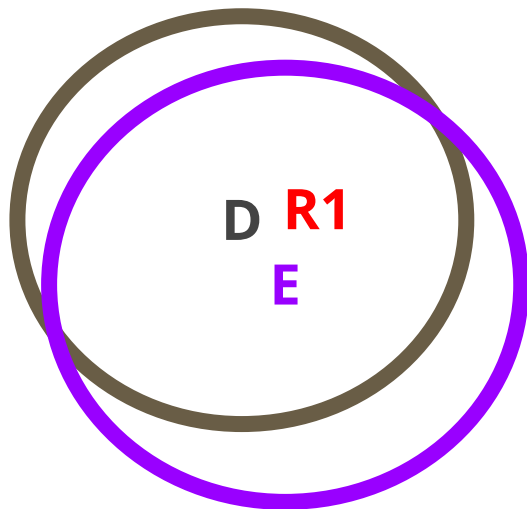
- end-to-end principle
- retransmit if no ack
- coordination



Carrier Sense Multiple Access (CSMA)

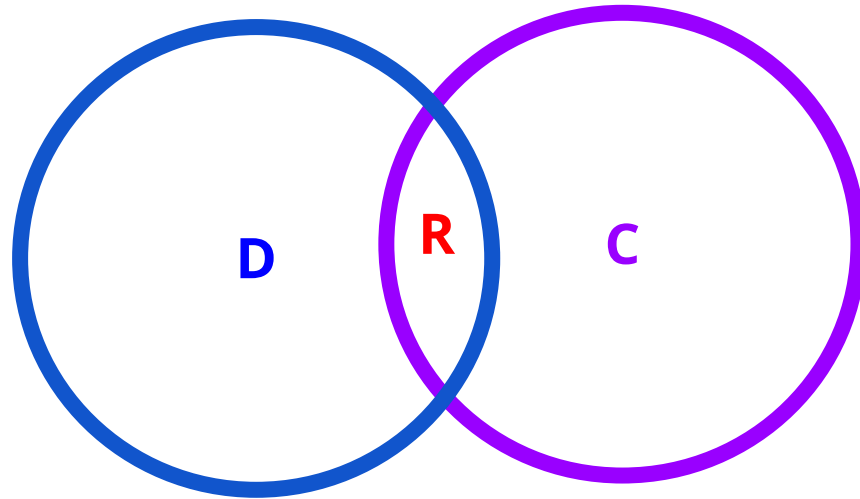
Key idea: listen for others on the medium and don't transmit if busy

- Works great when ranges of involved transmitters/receivers are all overlapping or completely disconnected



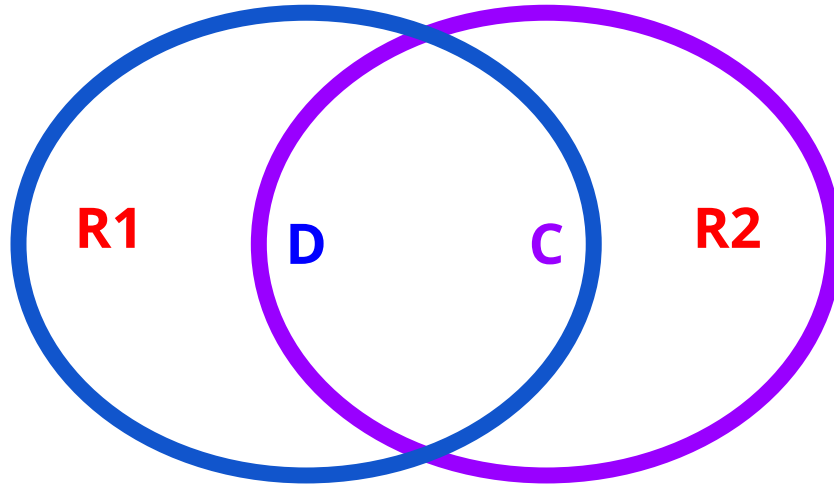
Hidden Terminal Problem

- A problem: two transmitters can't hear each other



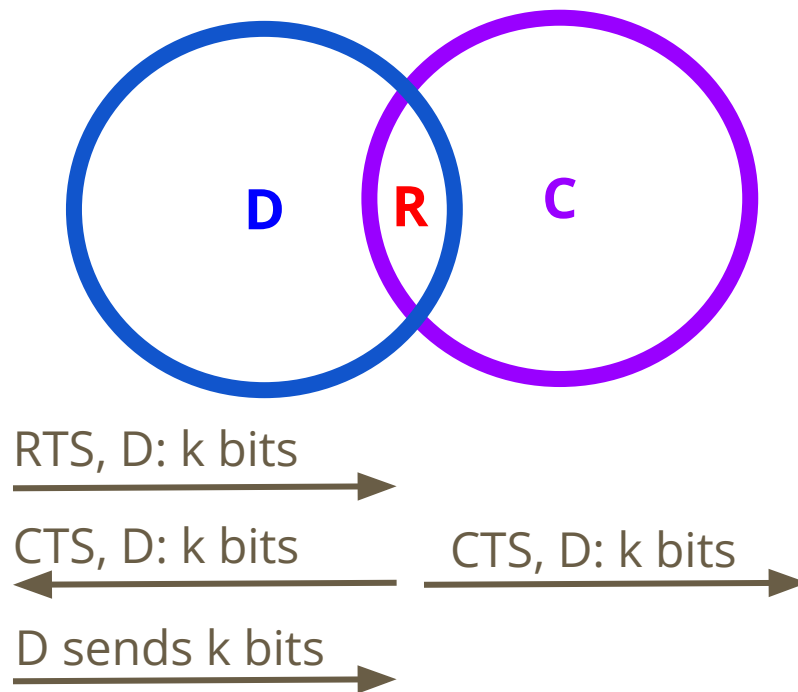
Exposed Terminal Problem

- Another problem: 'safe' transmissions could be blocked since D and C hear each other transmitting



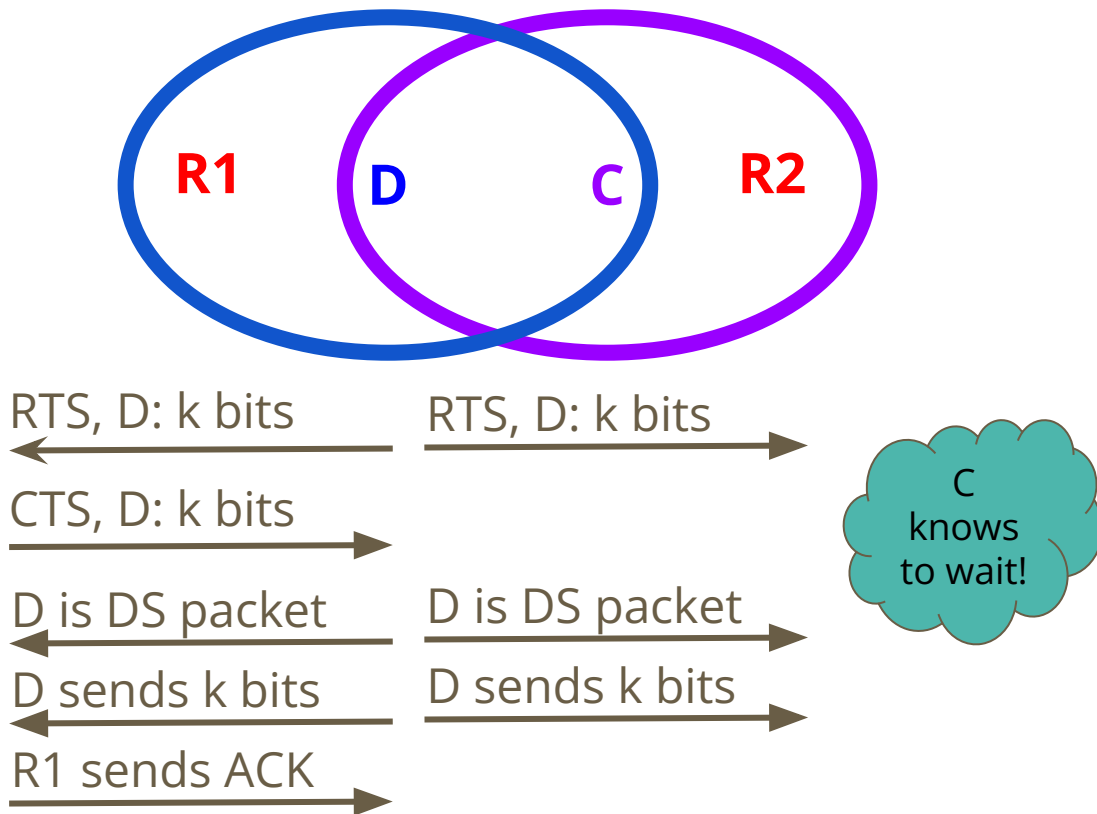
Request to Send / Clear to Send (RTS/CTS)

- Key idea: send a request-to-send and wait for a clear-to-send before transmitting



Multiple Access with Collision Avoidance for Wireless (MACAW)

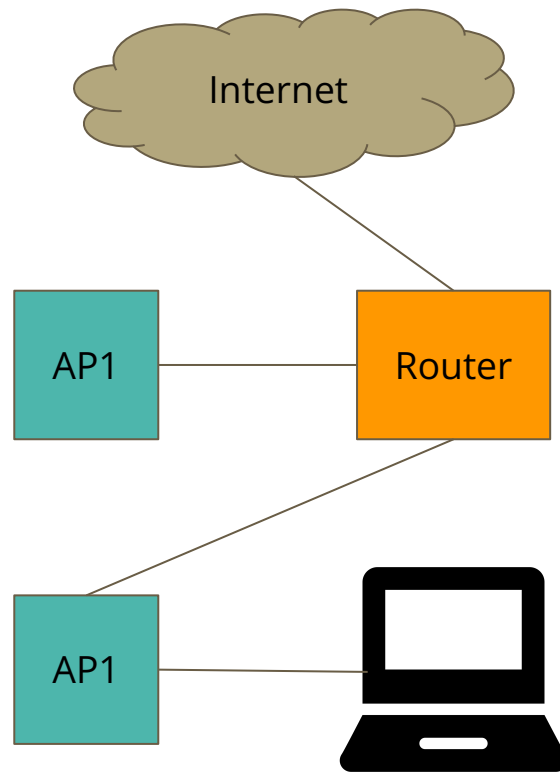
Key idea: Use RTS/CTS, but add backoff to deal with RTS collisions and reliability by using acks and a data sending indicator



WiFi

How does WiFi (802.11) work?

- Designed for a limited area (i.e. home)
- Access points (APs) set to a channel
- APs broadcast beacon messages with SSID (Service Set Identifier) and MAC Address periodically
- Hosts scan all channels to discover APs
- Hosts associate with AP



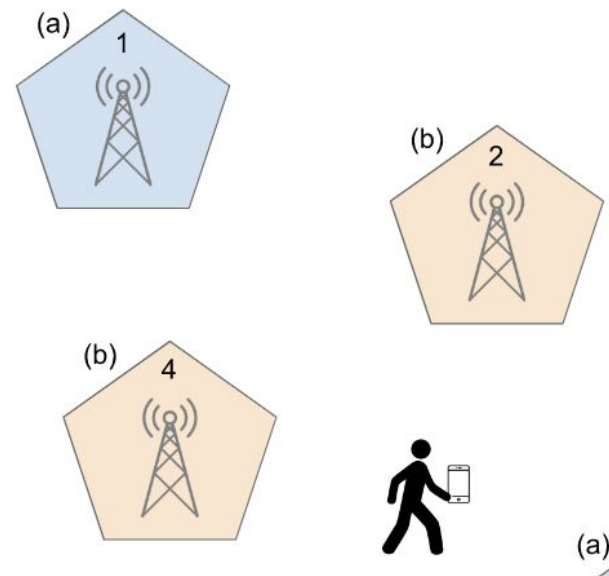
How does WiFi (802.11) work?

- Essentially uses CSMA (this is over simplified but details are out of scope)
- RTS/CTS is an optional feature (mainly used for large data transfers)
- Why would WiFi not use a full MACAW protocol all the time?

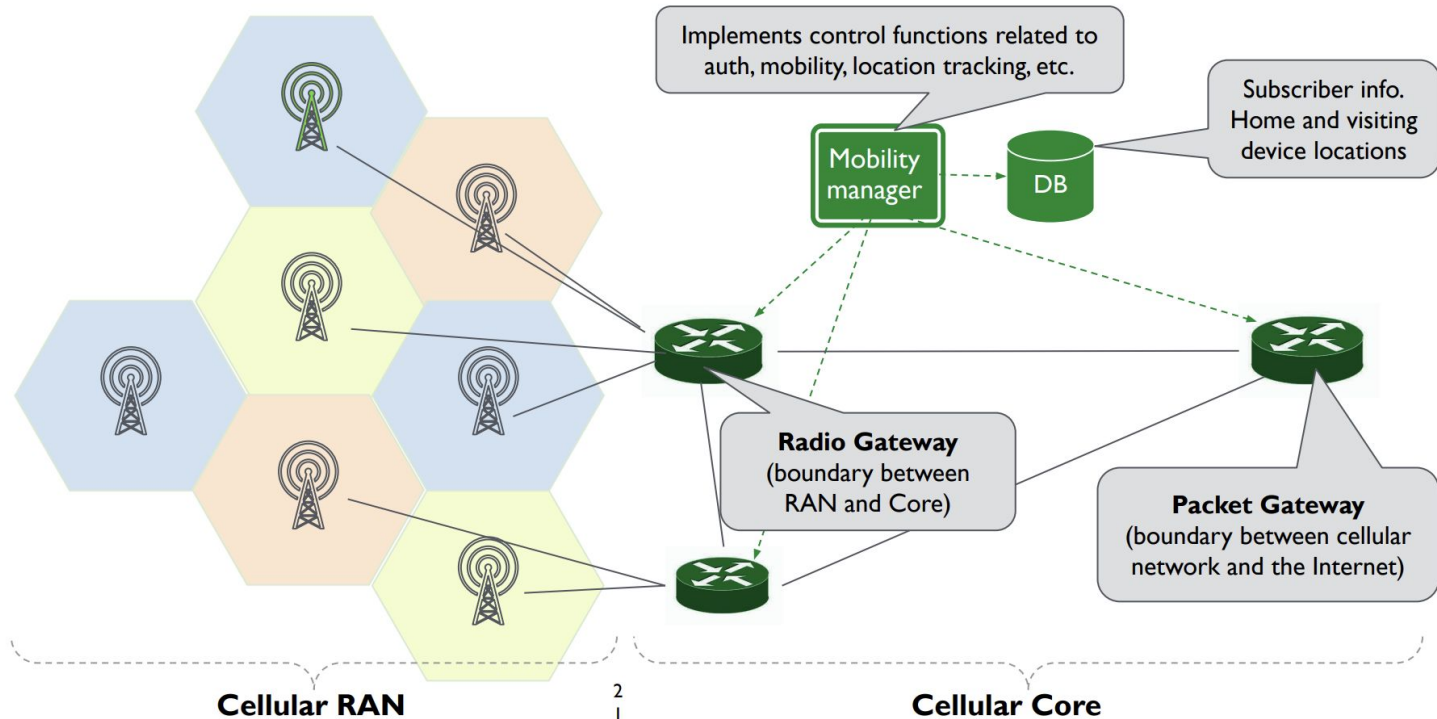
Cellular

How does cellular work?

- Key goal: Mobility
- Authentication and accountability are also first order goals
- Two Major Components:
 - Cellular RAN: between devices and cell towers
 - Cellular Core: between gateways and internet

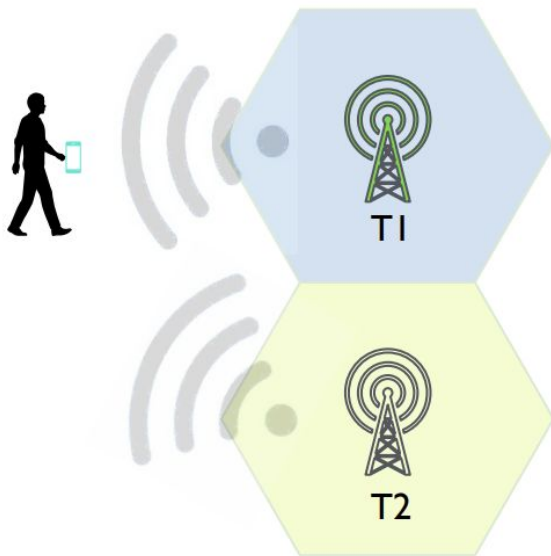


How does cellular work?



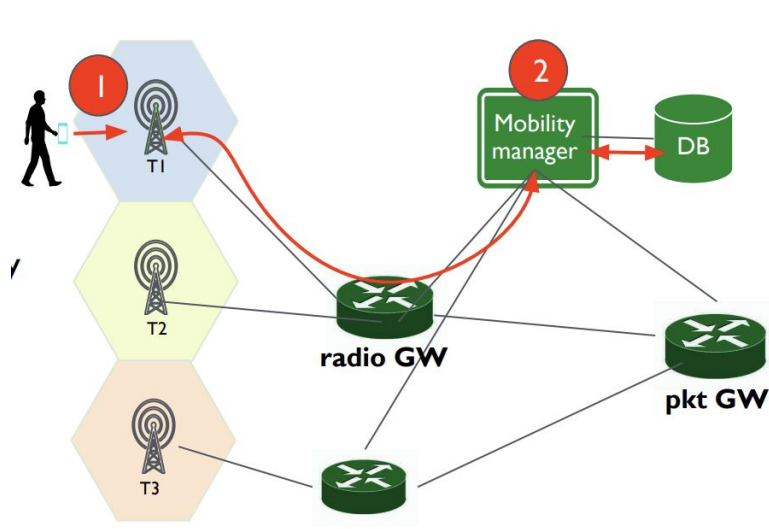
Discovery

- Towers transmit periodic “beacons” which ID the operator
- Device picks the best tower based on signal strength



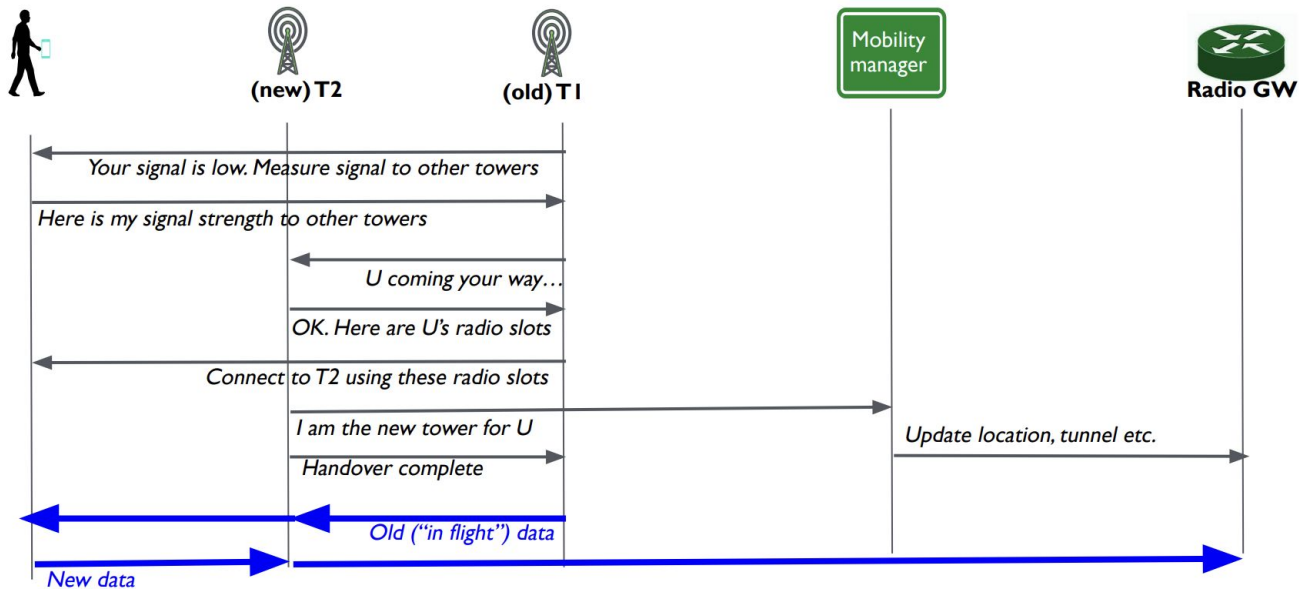
Attachment

- Device sends “attach request” to tower with best signal strength owned by operator.
- Request is processed/authenticated by the mobility manager



Handover

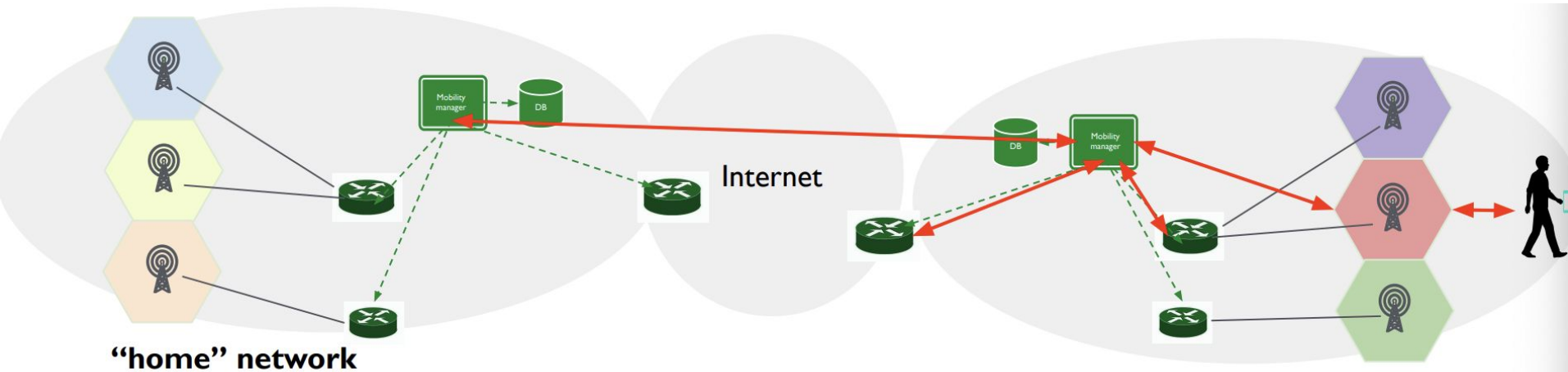
- Cooperatively done between U,T1,T2,mobility manager, radio gateway



Acknowledgements: adapted from Raj Jain's lectures

Roaming

- Mobility manager in the “visited” network has to check with the “home” network mobility manager for authentication.
- Can either route data through home network packet gateway or visited network packet gateway



Worksheet