

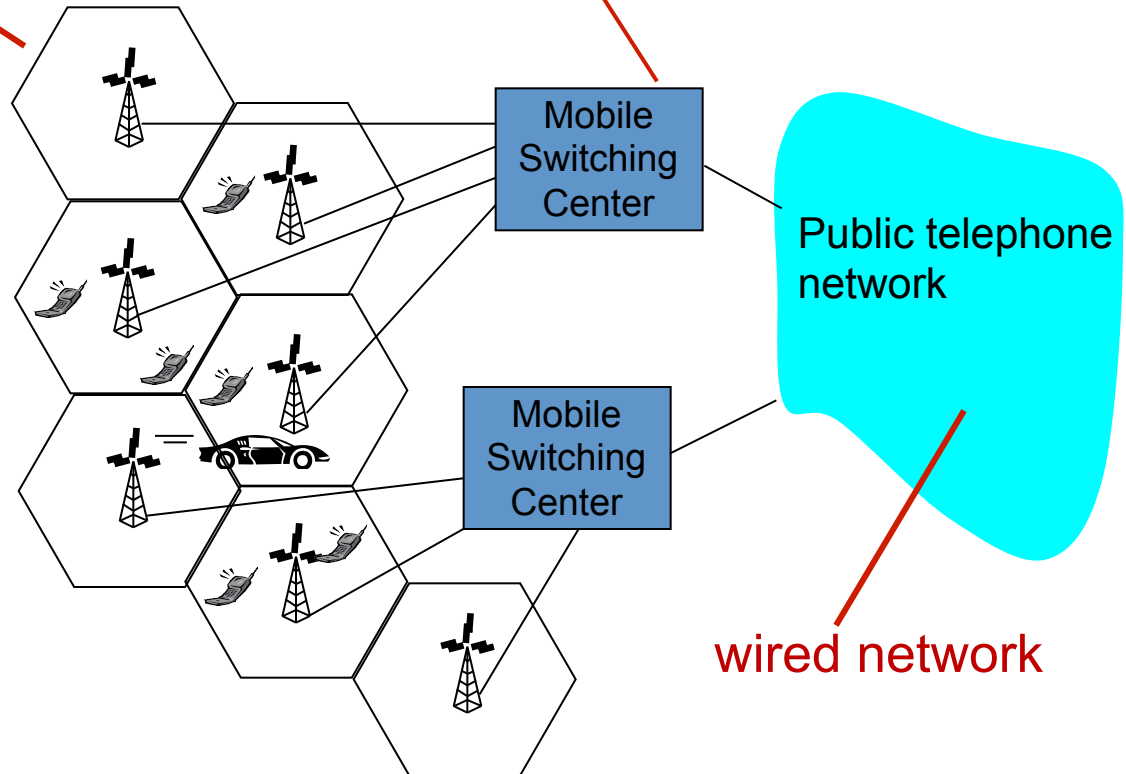
Components of cellular network architecture

cell

- ❖ covers geographical region
- ❖ *base station* (BS) analogous to 802.11 AP
- ❖ *mobile users* attach to network through BS
- ❖ *air-interface*: physical and link layer protocol between mobile and BS

MSC

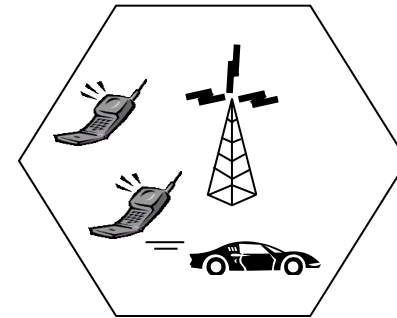
- ❖ connects cells to wired tel. net.
- ❖ manages call setup (more later!)
- ❖ handles mobility (more later!)



Cellular networks: the first hop

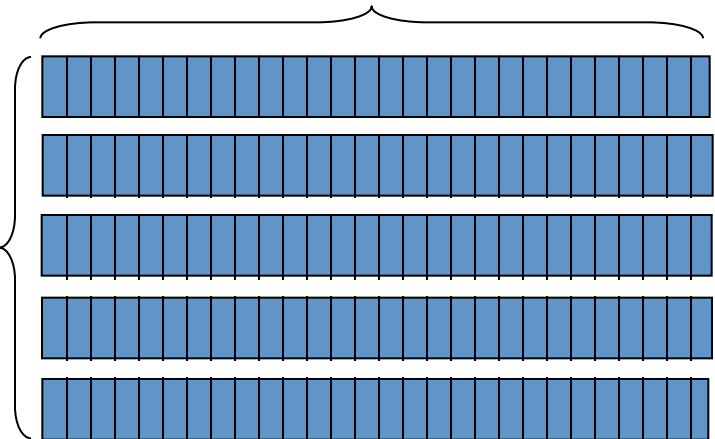
Two techniques for sharing mobile-to-BS radio spectrum

- **combined FDMA/TDMA:** divide spectrum in frequency channels, divide each channel into time slots
- **CDMA:** code division multiple access

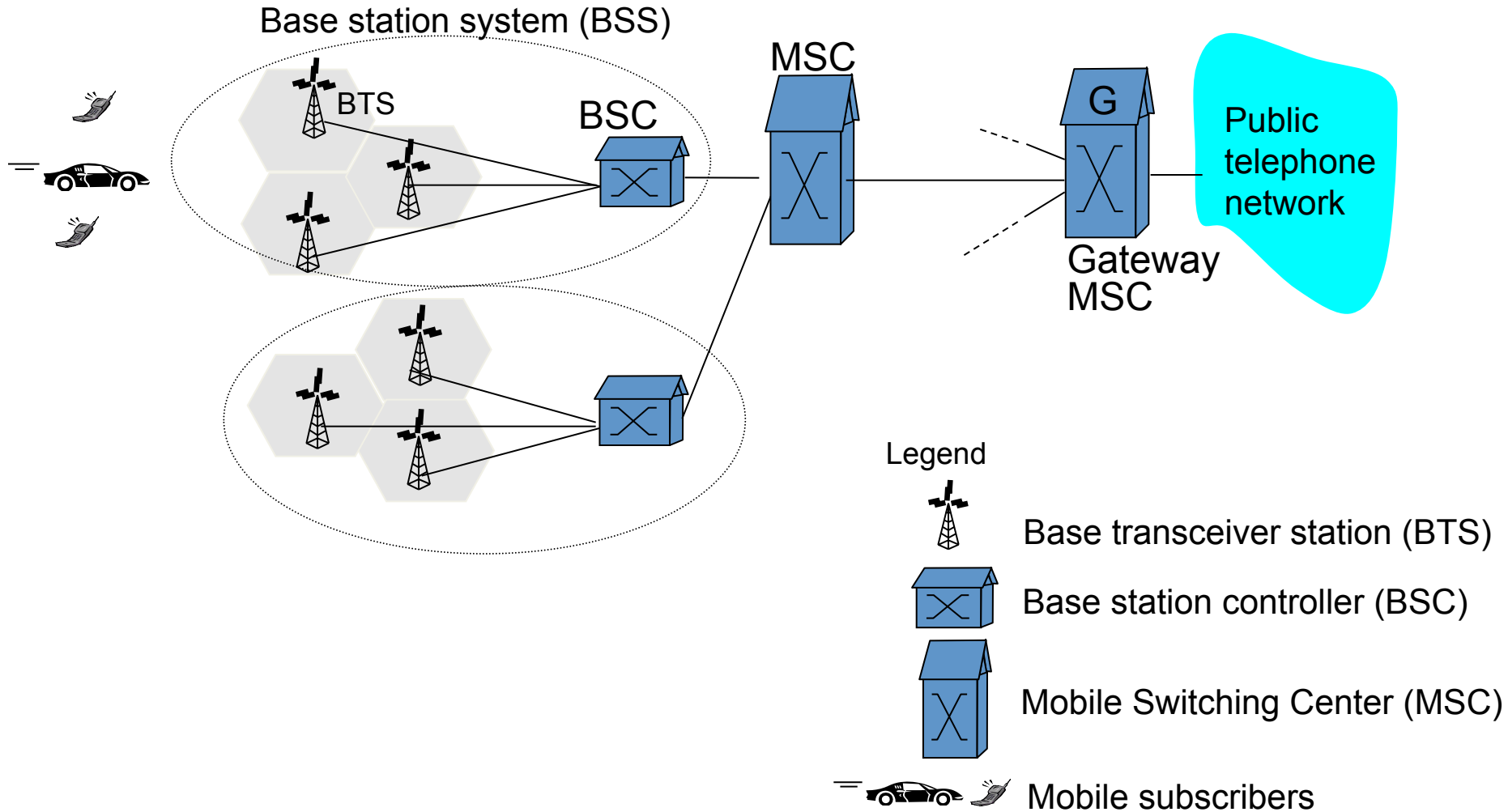


time slots

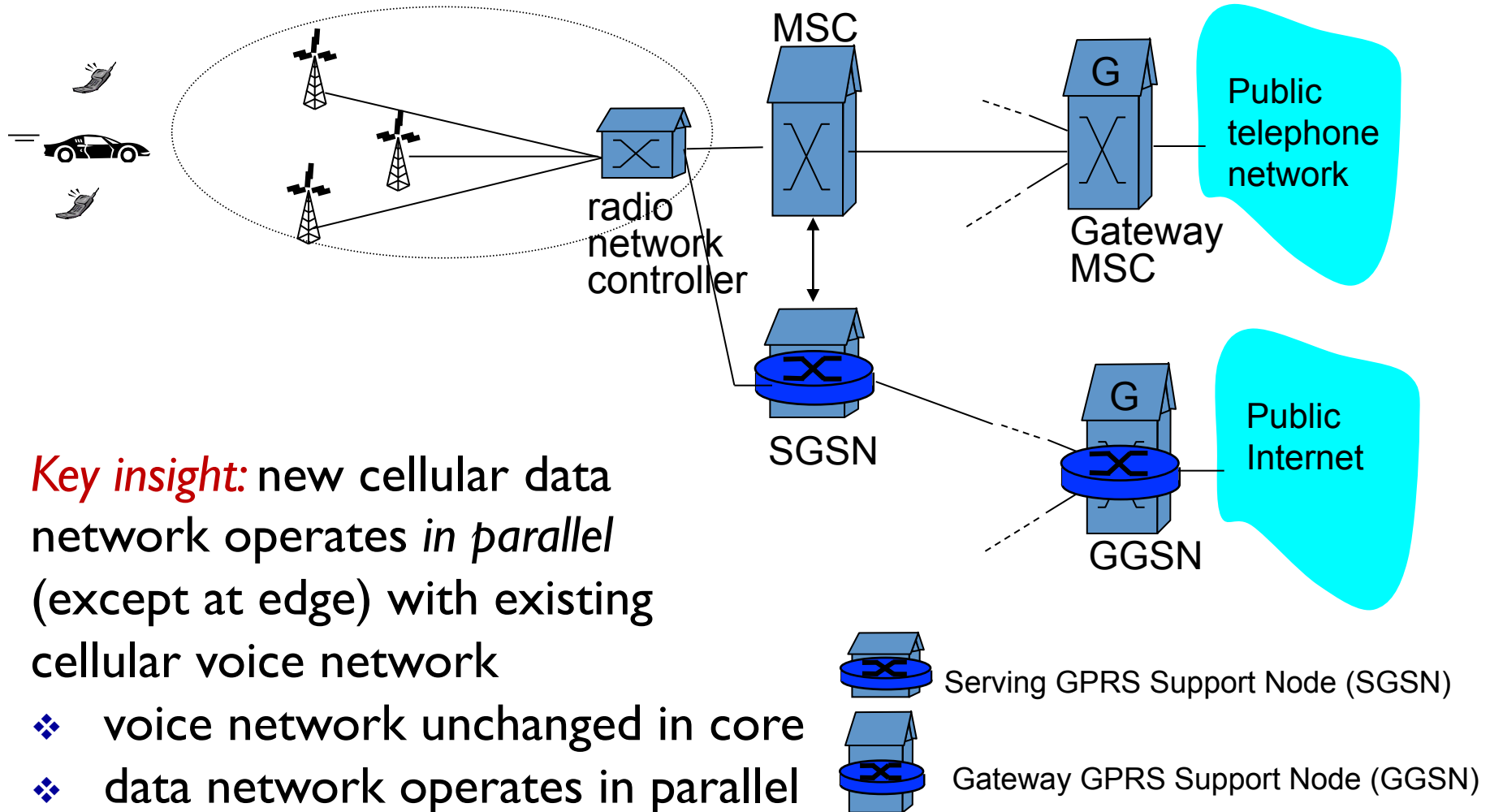
frequency bands



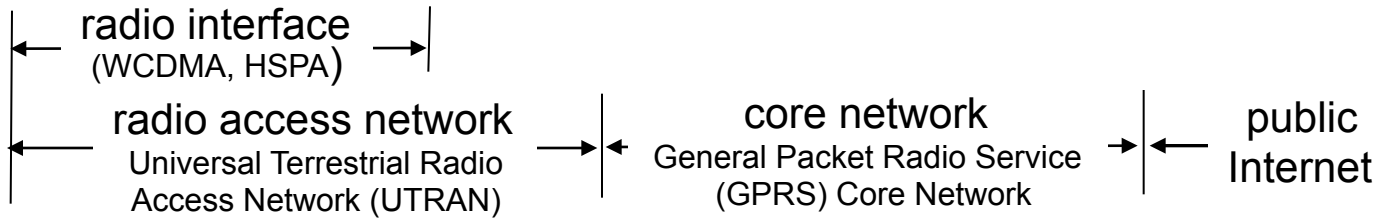
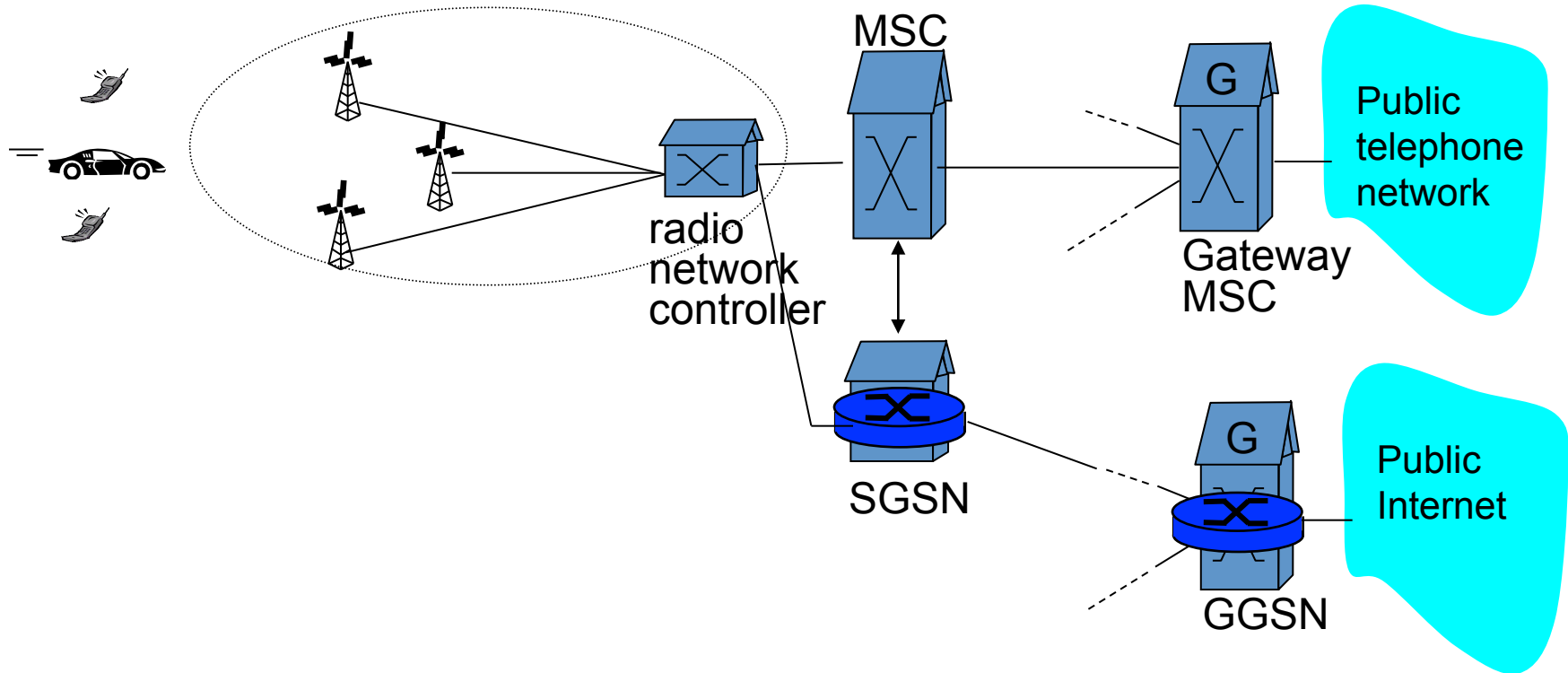
2G (voice) network architecture



3G (voice+data) network architecture

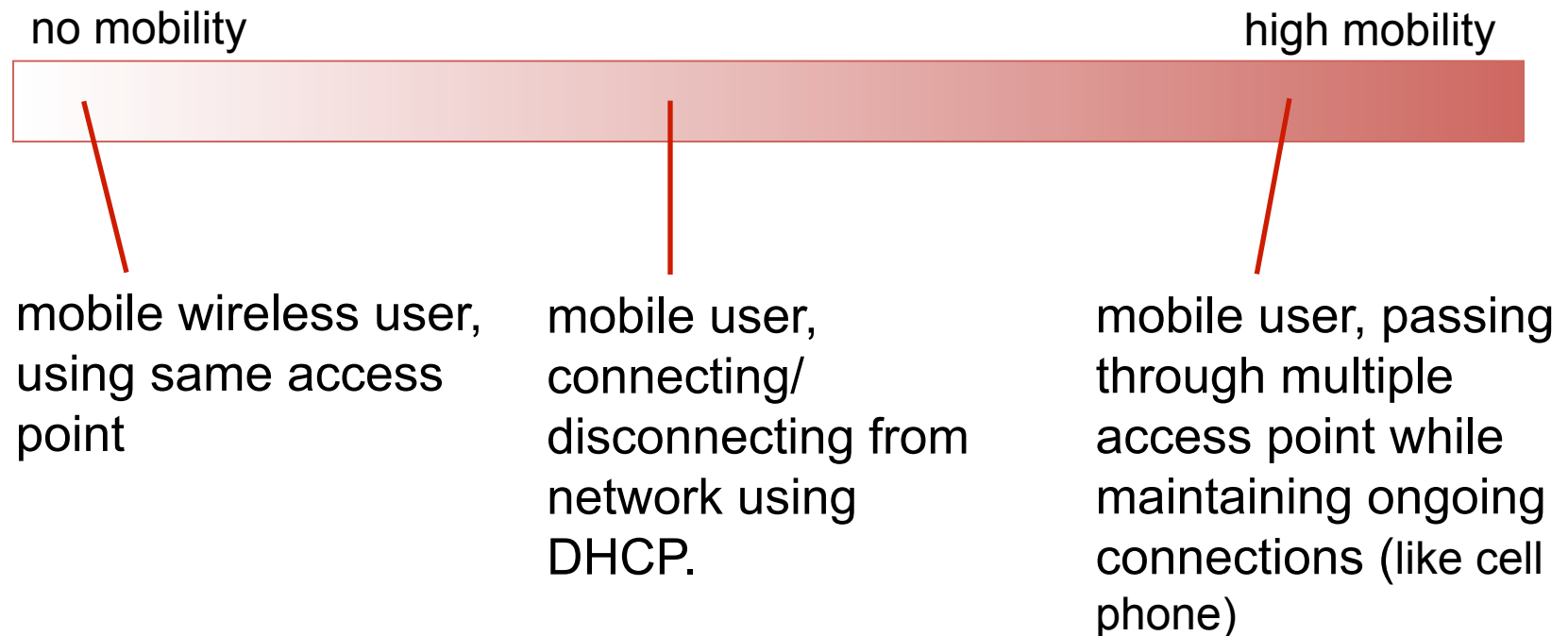


3G (voice+data) network architecture



What is mobility?

- spectrum of mobility, from the *network* perspective:

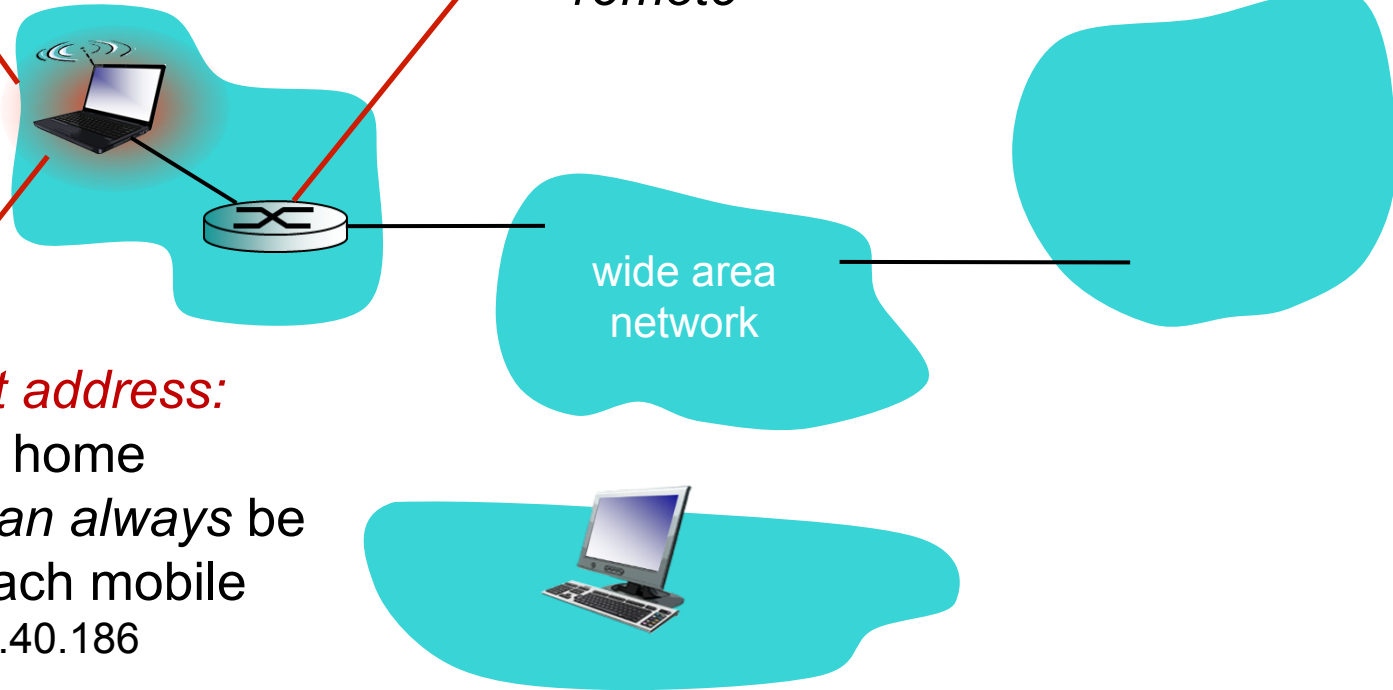


Mobility: vocabulary

home network: permanent
“home” of mobile
(e.g., 128.119.40/24)

home agent: entity that will
perform mobility functions on
behalf of mobile, when mobile is
remote

permanent address:
address in home
network, *can always* be
used to reach mobile
e.g., 128.119.40.186

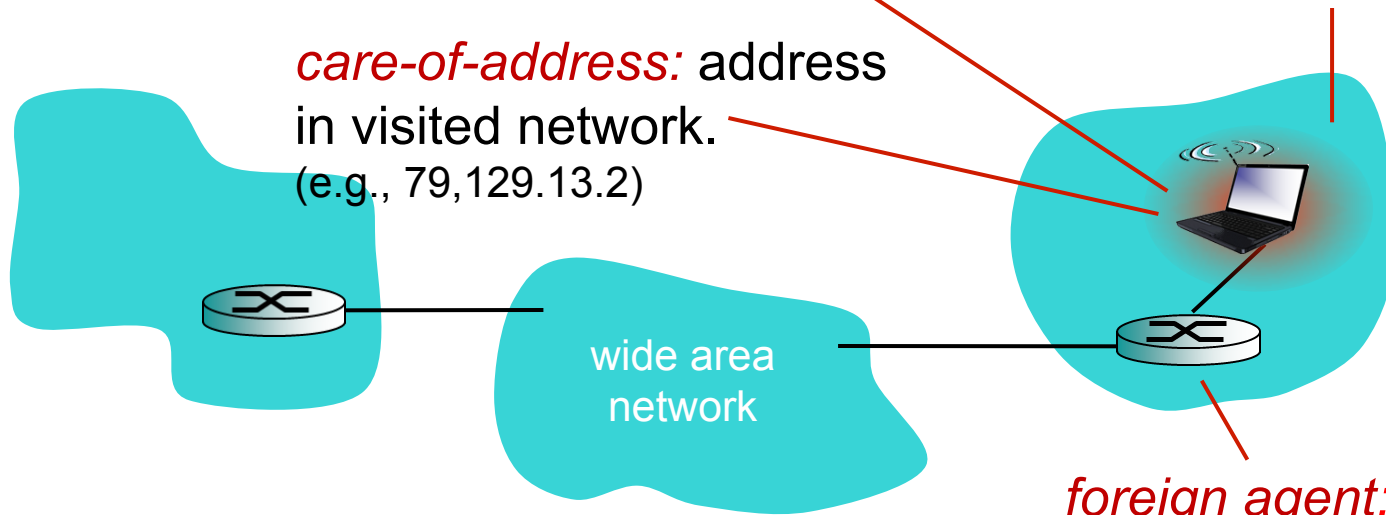


Mobility: more vocabulary

permanent address: remains constant (e.g., 128.119.40.186)

visited network: network in which mobile currently resides (e.g., 79.129.13/24)

care-of-address: address in visited network. (e.g., 79.129.13.2)



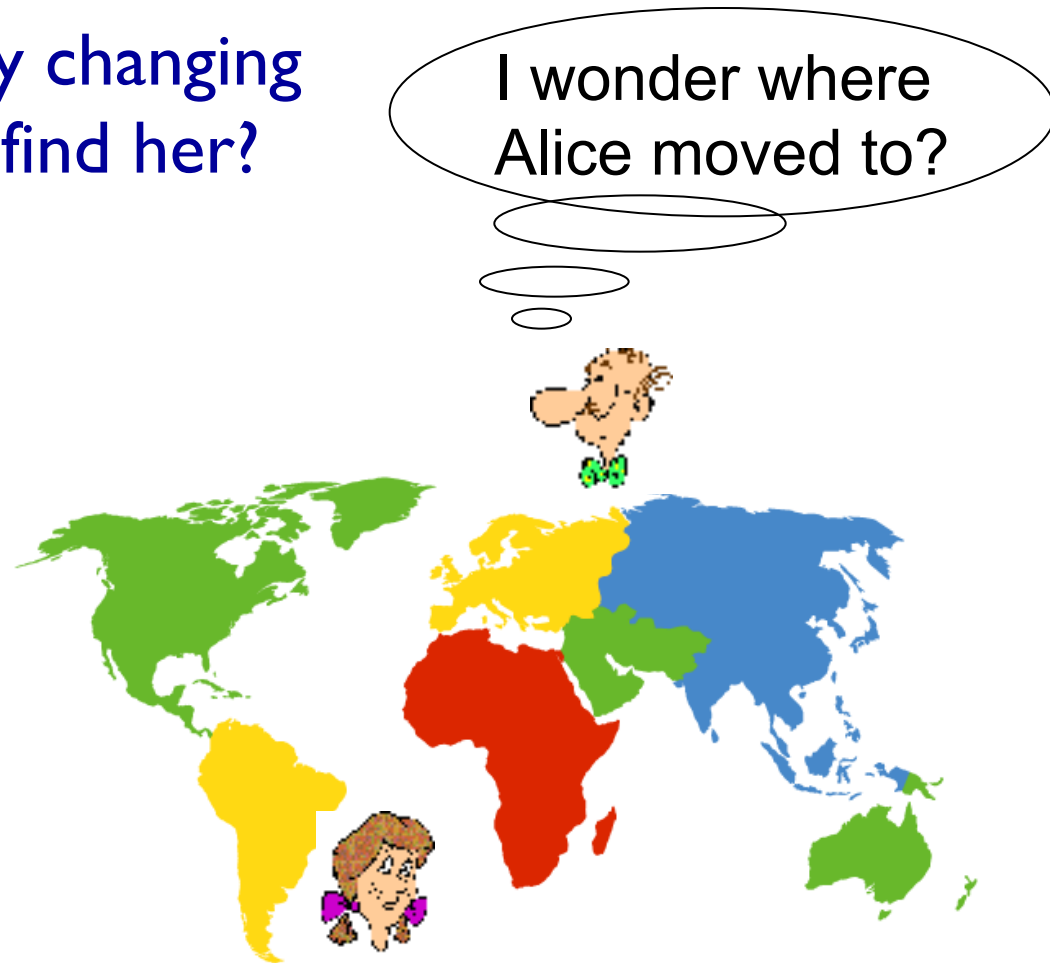
correspondent: wants to communicate with mobile

foreign agent: entity in visited network that performs mobility functions on behalf of mobile.

How do *you* contact a mobile friend:

Consider friend frequently changing addresses, how do you find her?

- search all phone books?
- call her parents?
- expect her to let you know where he/she is?



Mobility: approaches

- *let routing handle it:* routers advertise permanent address of mobile-nodes-in-residence via usual routing table exchange.
 - routing tables indicate where each mobile located
 - no changes to end-systems
- *let end-systems handle it:*
 - *indirect routing:* communication from correspondent to mobile goes through home agent, then forwarded to remote
 - *direct routing:* correspondent gets foreign address of mobile, sends directly to mobile

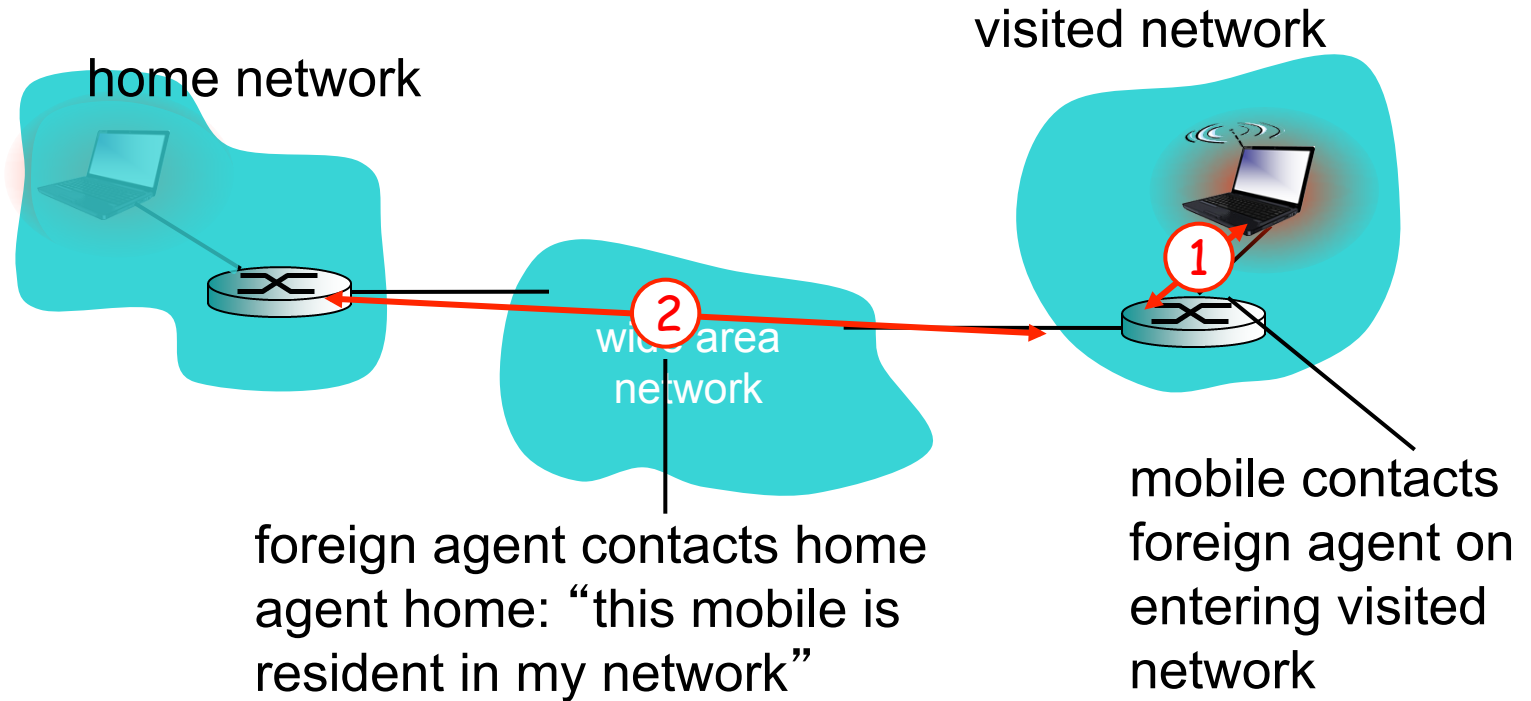
Mobility: approaches

- *let routing handle it: route and advertise permanent address of mobile-nodes-in-reverse* usual routing table exchange.
 - routing table not scalable to millions of mobiles where each mobile located
 - no changes to mobiles
- *let end-systems handle it.*
 - *indirect routing*: communication from correspondent to mobile goes through home agent, then forwarded to remote
 - *direct routing*: correspondent gets foreign address of mobile, sends directly to mobile

Select a correct statement

- A. A mobile device has a permanent address even it moves to another network
- B. A mobile device has a foreign address when it moves to another network
- C. An active connection between a correspondent and a mobile device is discontinued when the mobile device moves to another network
- D. A and B
- E. A, B and C

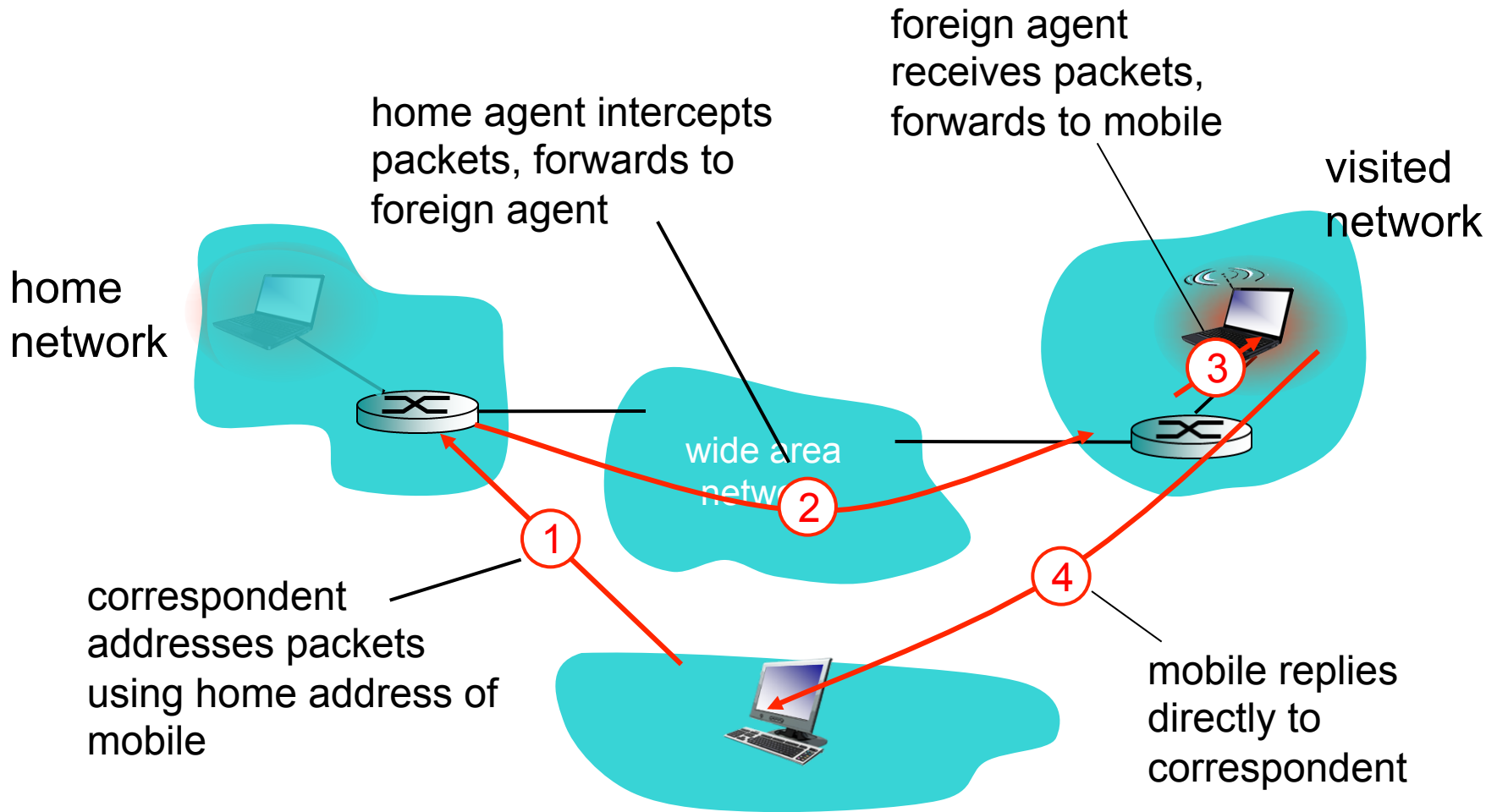
Mobility: registration



end result:

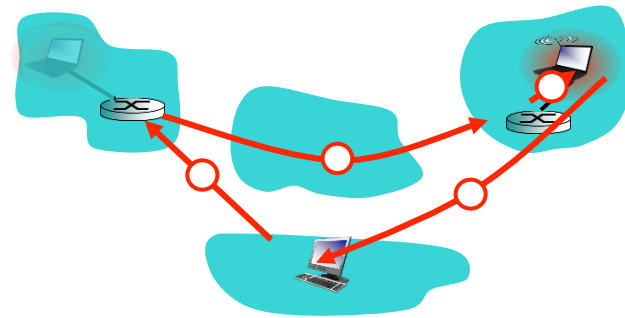
- foreign agent knows about mobile
- home agent knows location of mobile

Mobility via indirect routing



Indirect Routing: comments

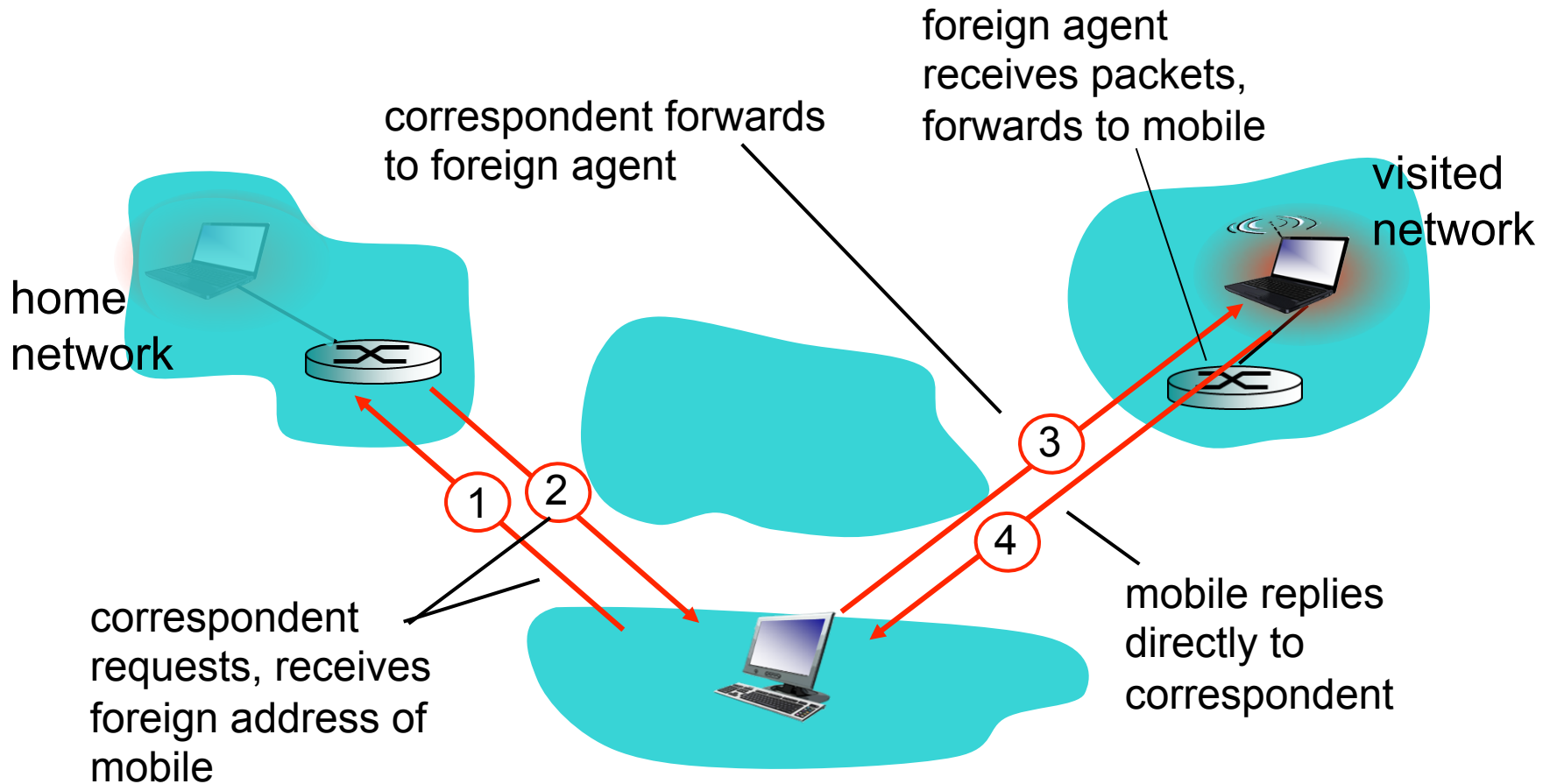
- mobile uses two addresses:
 - **permanent address**: used by correspondent (hence mobile location is *transparent* to correspondent)
 - **care-of-address**: used by home agent to forward datagrams to mobile
- foreign agent functions may be done by mobile itself
- **triangle routing**: correspondent-home-network-mobile
 - inefficient when correspondent, mobile are in same network



Indirect routing: moving between networks

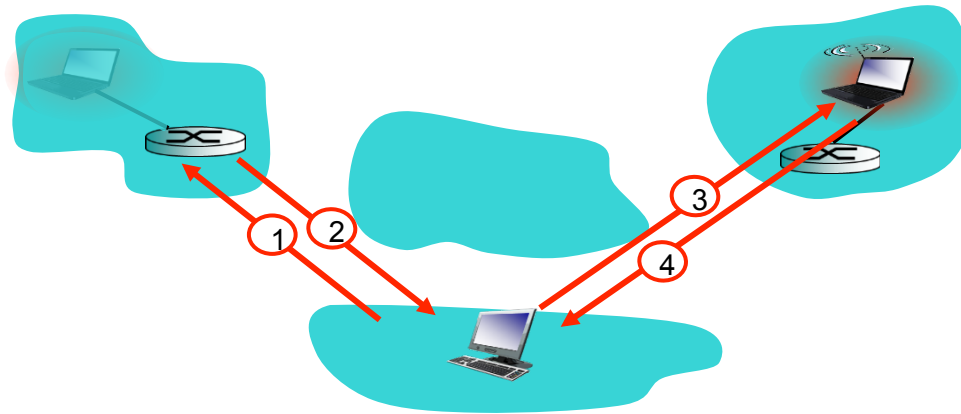
- suppose mobile user moves to another network
 - registers with new foreign agent
 - new foreign agent registers with home agent
 - home agent update care-of-address for mobile
 - packets continue to be forwarded to mobile (but with new care-of-address)
- mobility, changing foreign networks transparent: *on going connections can be maintained!*

Mobility via direct routing



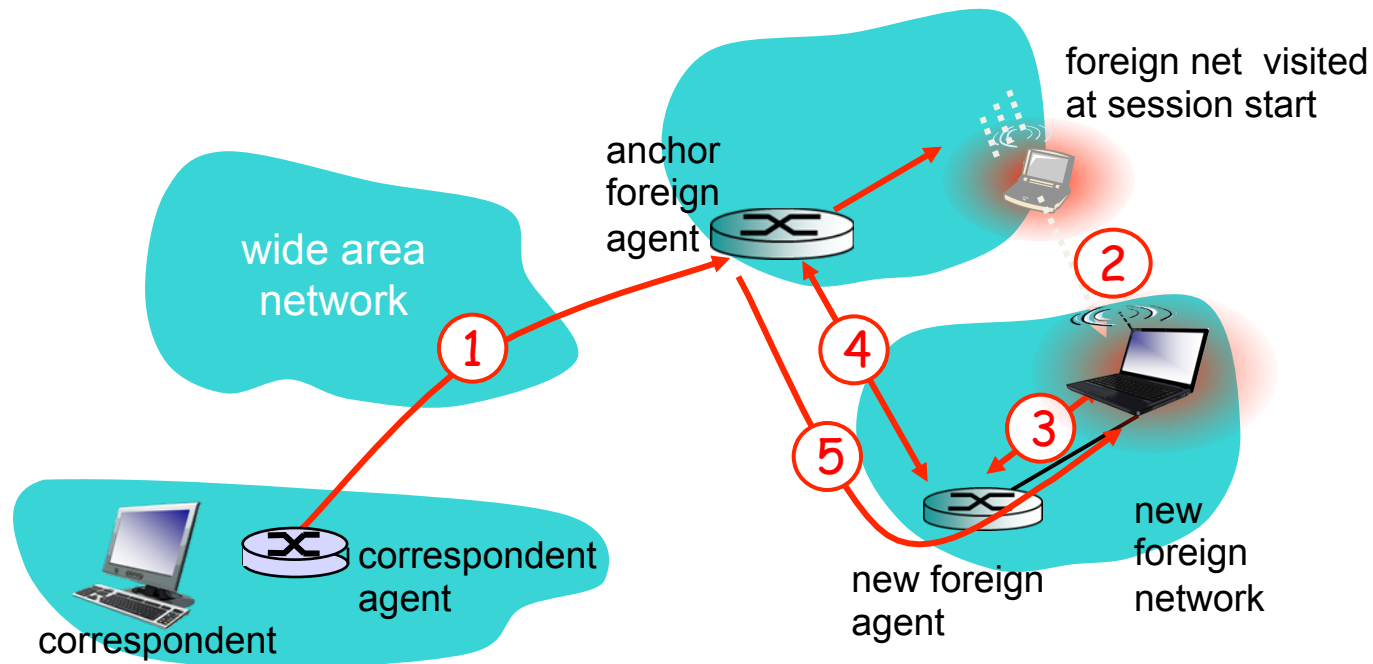
Mobility via direct routing: comments

- overcome triangle routing problem
- *non-transparent to correspondent:*
correspondent must get care-of-address from home agent
 - what if mobile changes visited network?



Accommodating mobility with direct routing

- anchor foreign agent: FA in first visited network
- data always routed first to anchor FA
- when mobile moves: new FA arranges to have data forwarded from old FA (chaining)



Select a correct statement

- A. In indirect routing, location and foreign address of a mobile device are transparent to correspondent
- B. In direct routing, foreign address of a mobile device are needed for correspondent to establish a connection
- C. In direct routing, mobility to another network will interrupt an ongoing connection
- D. A and B
- E. A, B and C

Next lecture

- Security in Computer Networks
Readings Chapter 8