

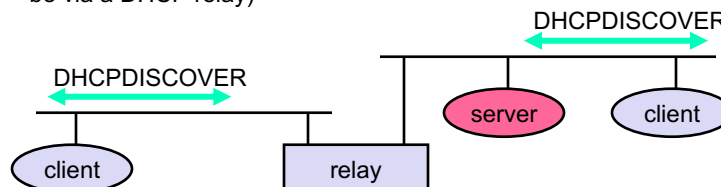
# MOBILE COMPUTING

CSE 40814/60814  
Spring 2021

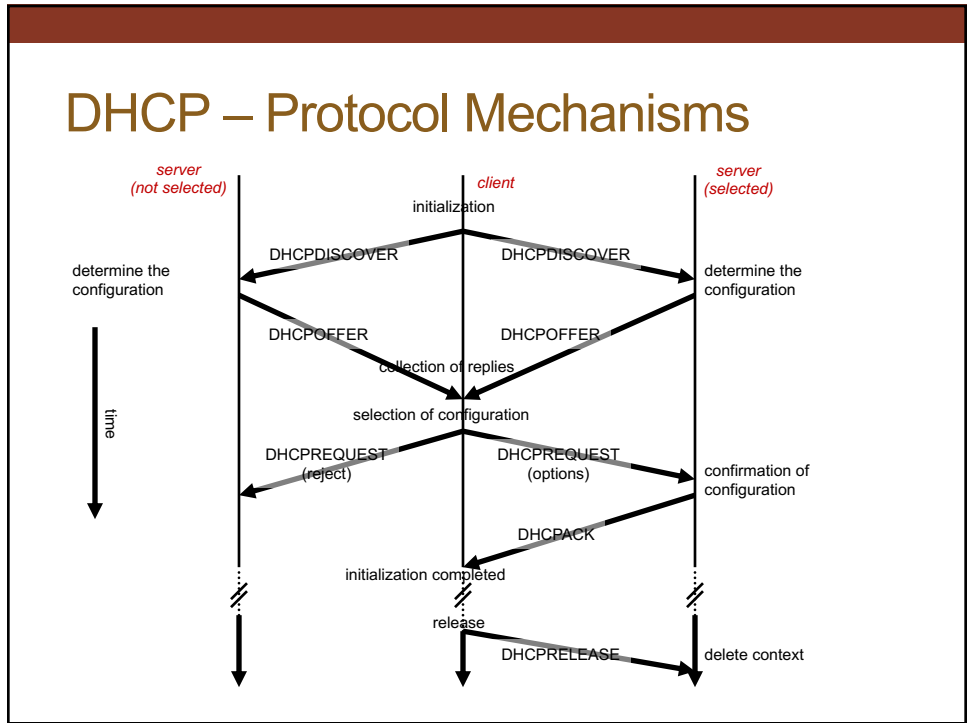


## Dynamic Host Configuration Protocol

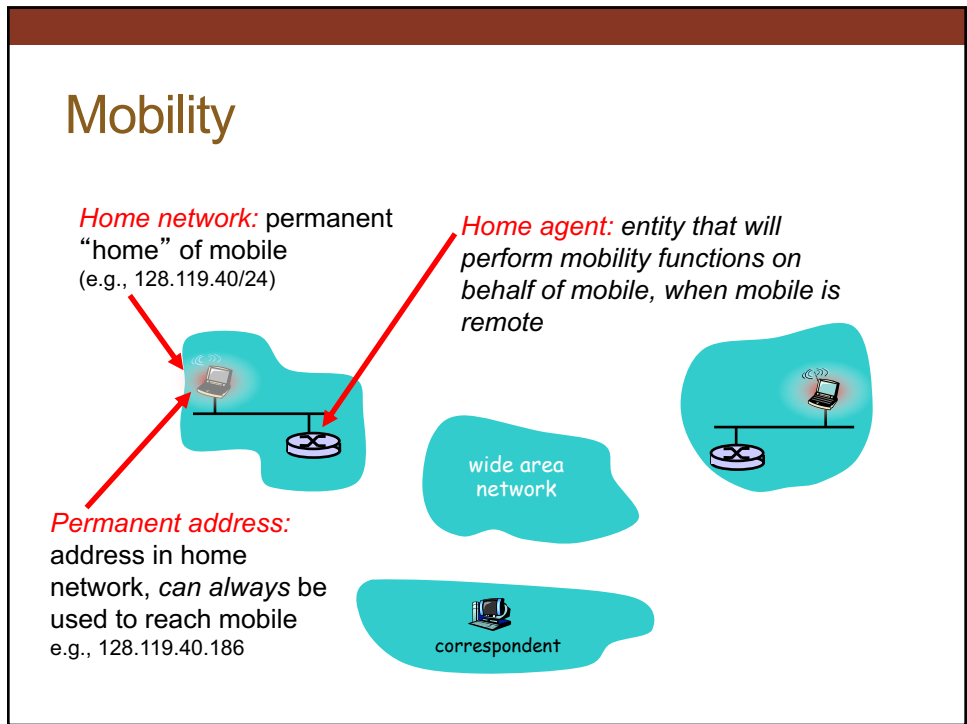
- Application
  - simplification of installation and maintenance of networked computers
  - supplies systems with all necessary information, such as IP address, DNS server address, domain name, subnet mask, default router etc.
  - enables automatic integration of systems into an Intranet or the Internet, can be used to acquire a COA for Mobile IP (see later)
- Client/Server-Model
  - the client sends via a MAC broadcast a request to the DHCP server (might be via a DHCP relay)



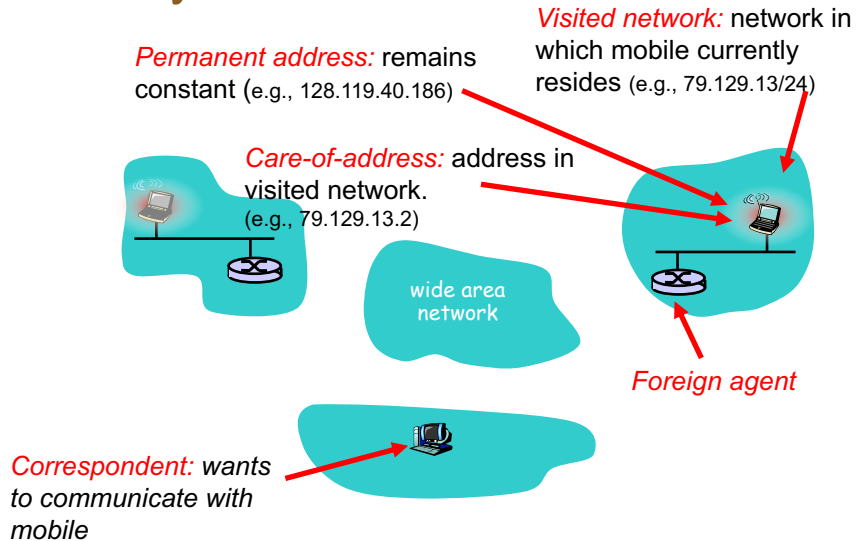
## DHCP – Protocol Mechanisms



## Mobility



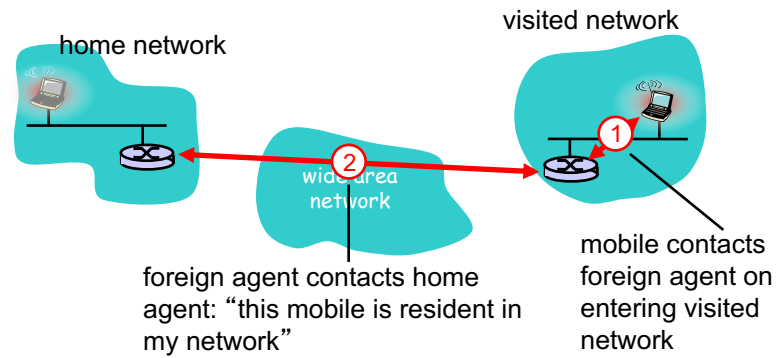
## Mobility



## Finding Somebody

- 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
  - NOT SCALABLE!
- 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

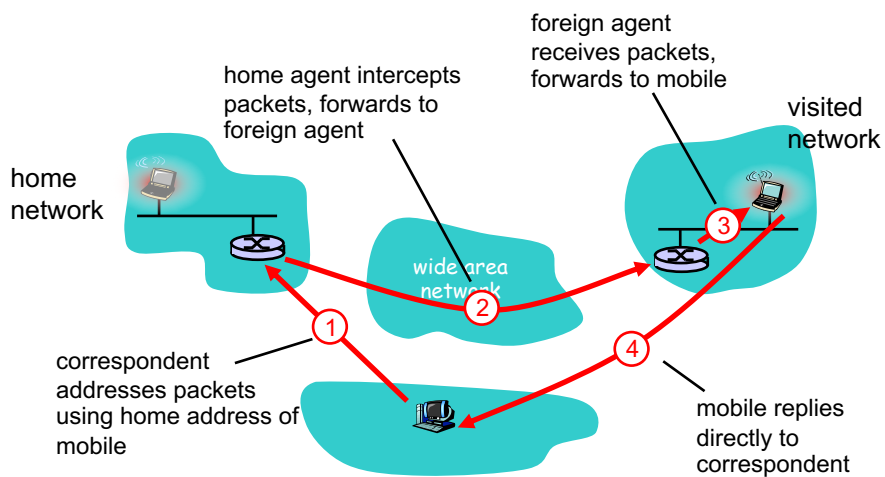
## Mobility: Registration



End result:

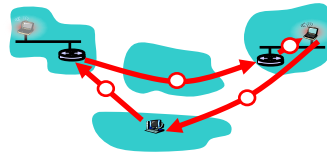
- Foreign agent knows about mobile
- Home agent knows location of mobile

## Mobility via Indirect Routing



## Indirect Routing: Comments

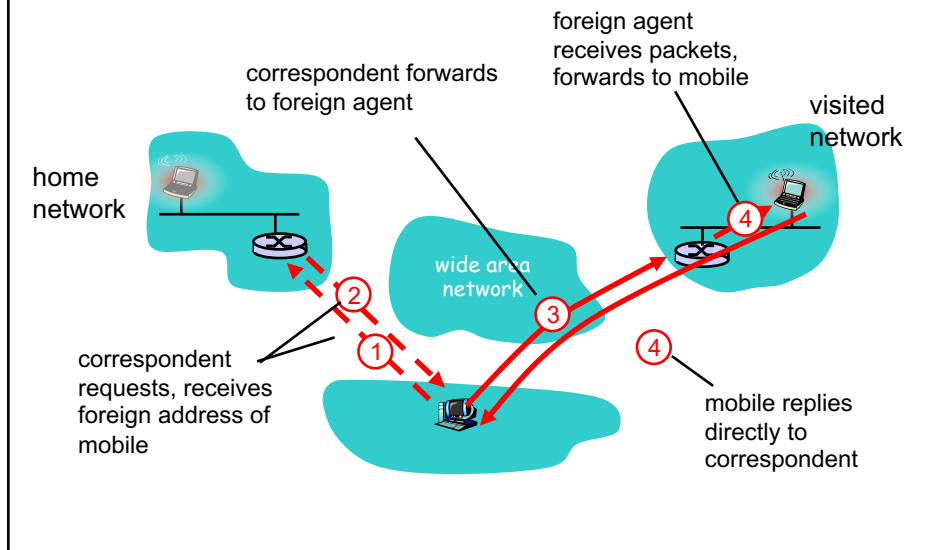
- Mobile uses two addresses:
  - **permanent address**: used by correspondent (hence mobile location is *transparent* to correspondent)
  - **care-of-address**: used by home agent to forward datagrams to mobile
- foreign agent functions may be done by mobile itself
- **triangle routing**: correspondent-home-network-mobile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



## Indirect Routing: Moving Between Networks

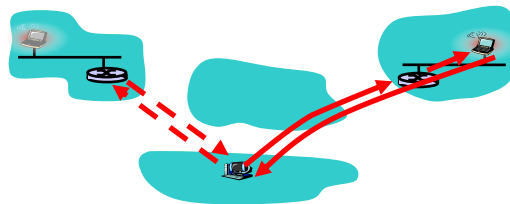
- Suppose mobile user moves to another network
  - registers with new foreign agent
  - new foreign agent registers with home agent
  - home agent updates care-of-address for mobile
  - packets continue to be forwarded to mobile (but with new care-of-address)
- Mobility, changing foreign networks transparent: *ongoing connections can be maintained!*

## Mobility via Direct Routing



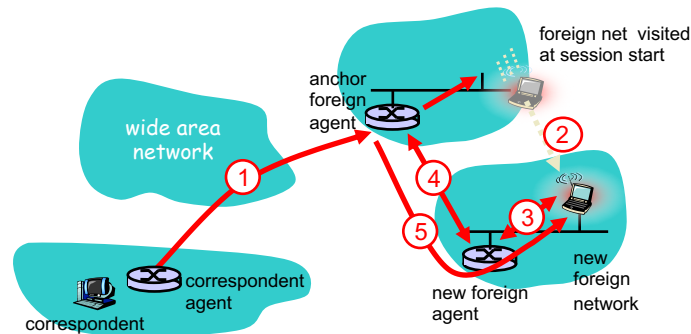
## Mobility via Direct Routing: Comments

- 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

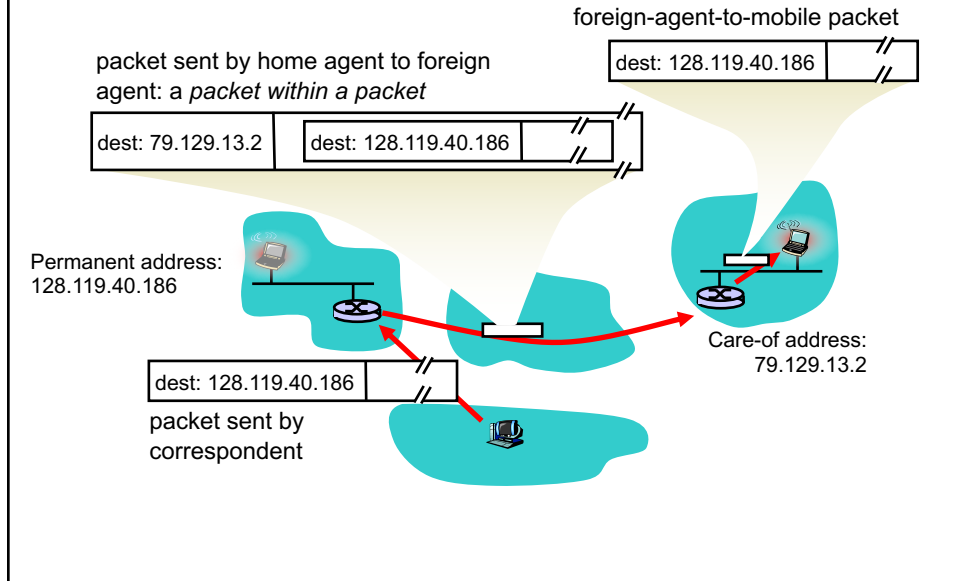
- Anchor foreign agent: “anchor FA” in first visited network
- Data always routed first to anchor FA
- When mobile moves: new FA arranges to have data forwarded from old FA (chaining)



## Mobile IP

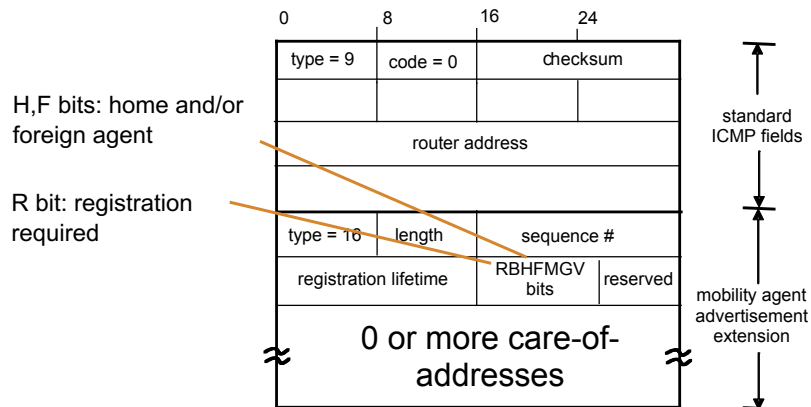
- RFC 3220
- Has many features we've seen:
  - home agents, foreign agents, foreign-agent registration, care-of-addresses, encapsulation (packet-within-a-packet)
- Three components to standard:
  - indirect routing of datagrams
  - agent discovery
  - registration with home agent

## Mobile IP: Indirect Routing



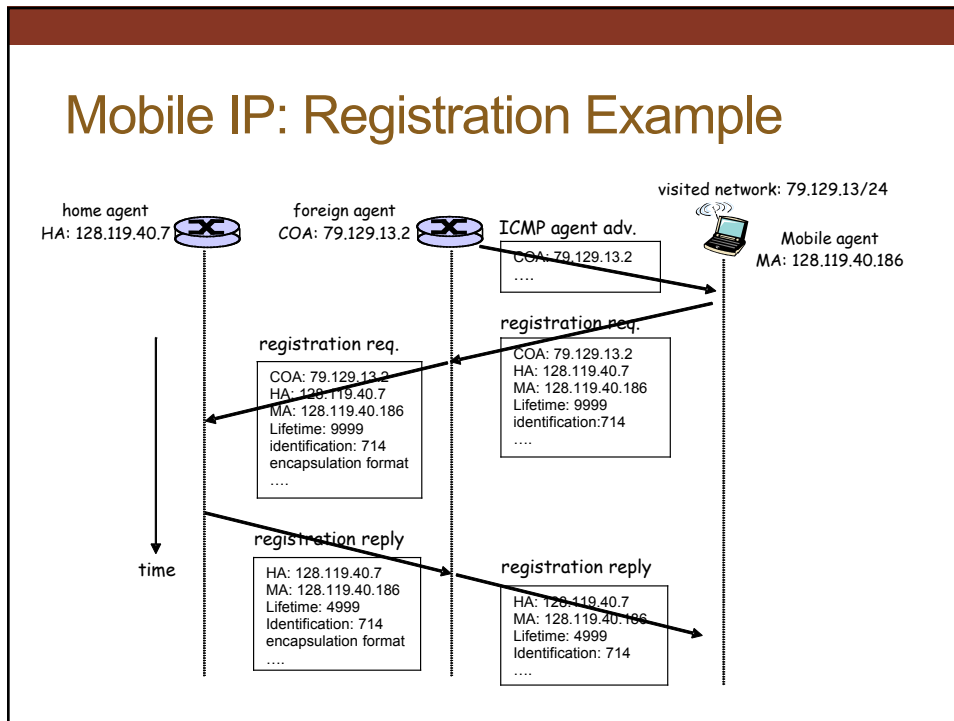
## Mobile IP: Agent Discovery

- **Agent advertisement:** foreign/home agents advertise service by broadcasting ICMP messages (typefield = 9)

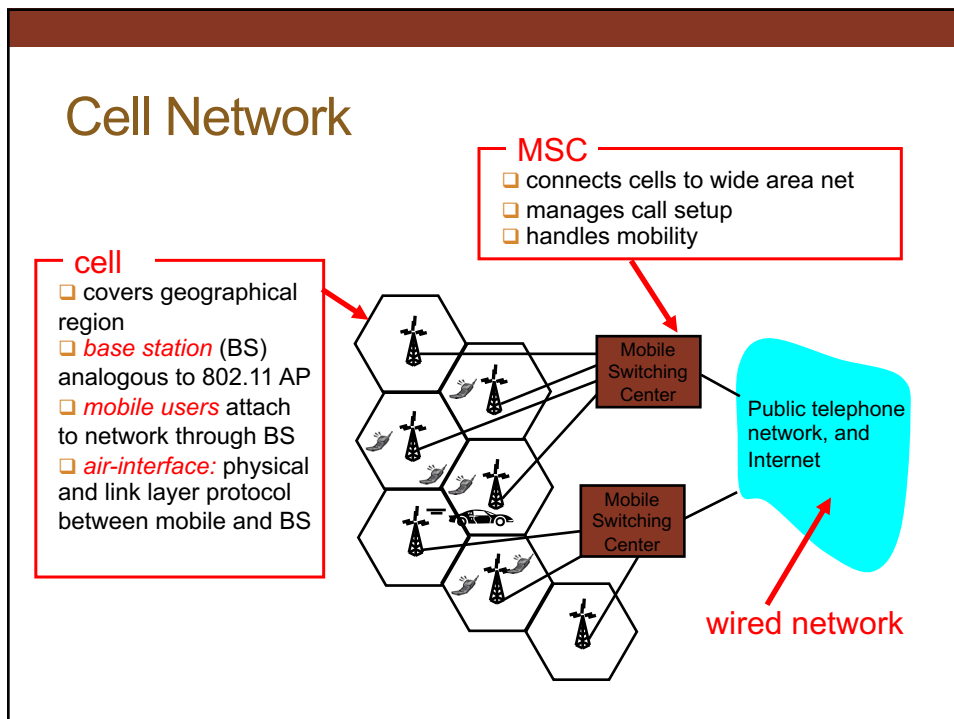




## Mobile IP: Registration Example



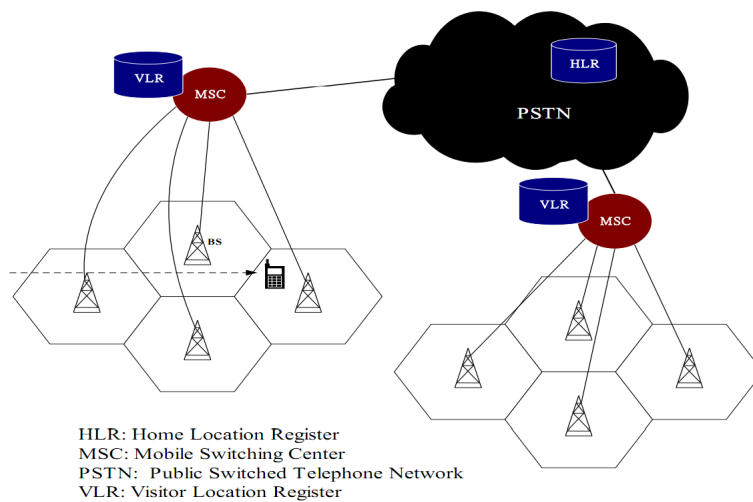
## Cell Network



## Mobility Management

- Challenge: roaming message destination
  - Location management
  - Roaming management
  - Handoff management

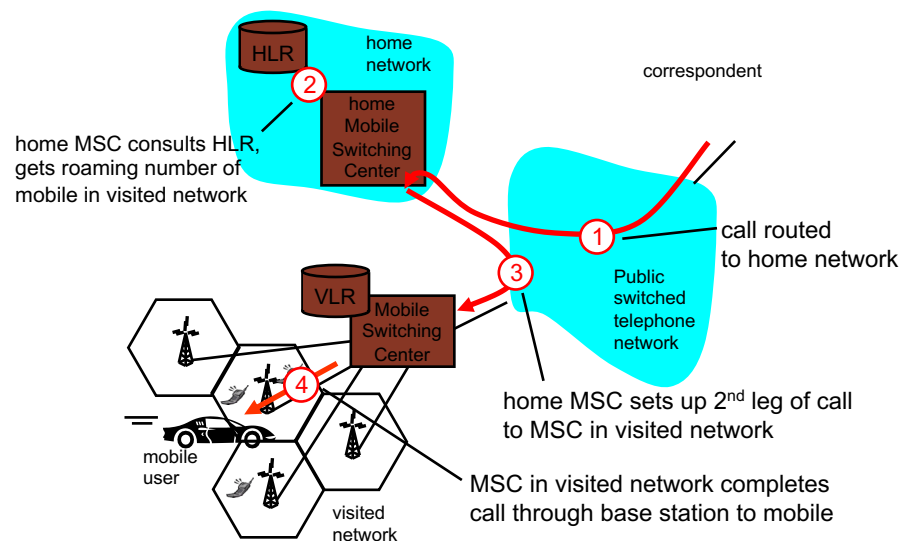
## Example: Cellular Networks



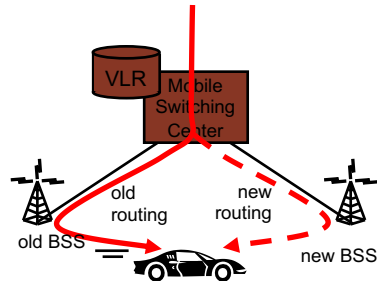
## Mobility in Cellular Networks

- **Home network:** network of cellular provider you subscribe to (e.g., AT&T, T-Mobile, Verizon)
  - **home location register (HLR):** database in home network containing permanent cell phone #, profile information (services, preferences, billing), information about current location (could be in another network)
- **Visited network:** network in which mobile currently resides
  - **visitor location register (VLR):** database with entry for each user currently in network
  - could be home network

## GSM: Indirect Routing

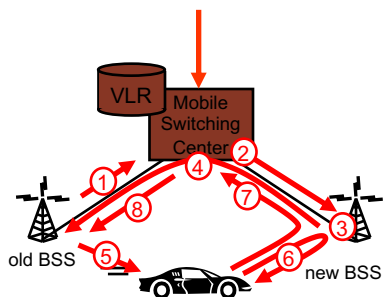


## GSM: Handoff with Common MSC



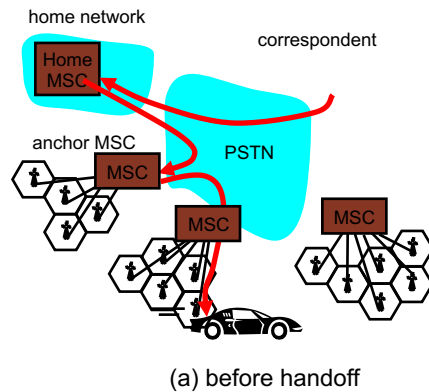
- Handoff goal: route call via new base station (without interruption)
- Reasons for handoff:
  - stronger signal to/from new BSS (continuing connectivity, less battery drain)
  - load balance: free up channel in current BSS
  - GSM doesn't mandate why to perform handoff (policy), only how (mechanism)
- Handoff initiated by old BSS

## GSM: Handoff with Common MSC



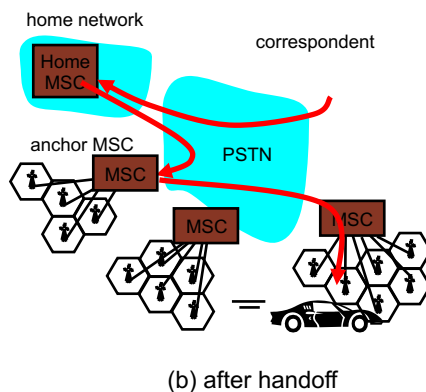
1. old BSS informs MSC of impending handoff, provides list of 1+ new BSSs
2. MSC sets up path (allocates resources) to new BSS
3. new BSS allocates radio channel for use by mobile
4. new BSS signals MSC, old BSS: ready
5. old BSS tells mobile: perform handoff to new BSS
6. mobile, new BSS signal to activate new channel
7. mobile signals via new BSS to MSC: handoff complete. MSC reroutes call
8. MSC-old-BSS resources released

## GSM: Handoff Between MSCs



- **Anchor MSC:** first MSC visited during call
  - call remains routed through anchor MSC
- new MSCs add on to end of MSC chain as mobile moves to new MSC
- IS-41 allows optional path minimization step to shorten multi-MSC chain

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