

CN-Advanced L43

Mobility in Cellular Networks

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Chapter 6 Wireless and Mobile Networks

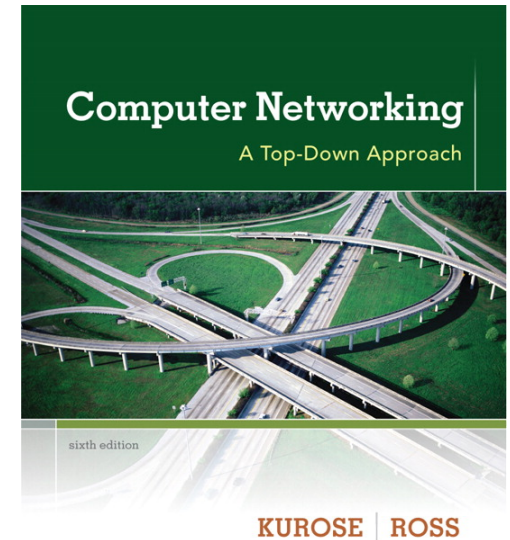
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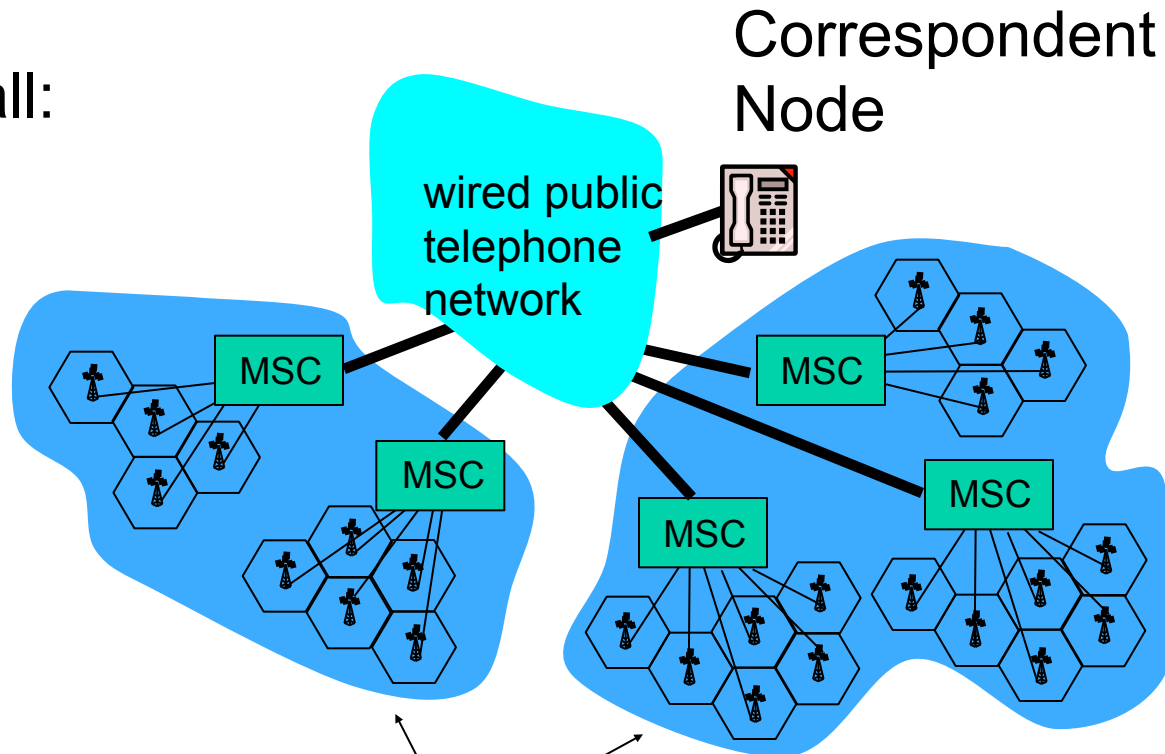
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**Computer
Networking: A Top
Down Approach**
6th edition
Jim Kurose, Keith Ross
Addison-Wesley
March 2012

Components of cellular network architecture

recall:



Different cellular networks,
Operated by different providers

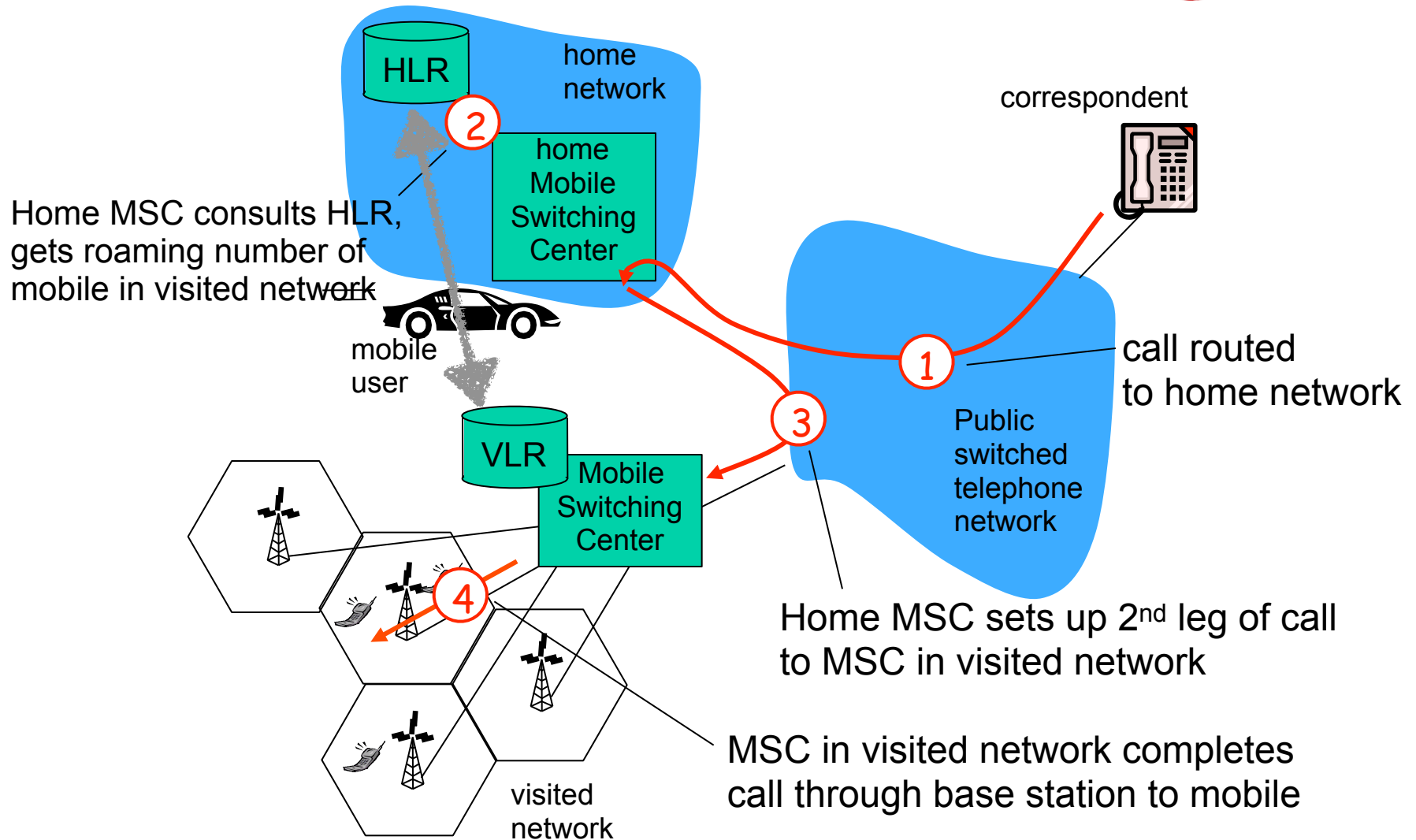
Handling mobility in cellular networks

- Similarities with Mobile IP?
- Call Routing?
 - Indirect or Direct
 - If indirect, is it triangular routing?
- Responsibilities of Home and Visited Networks
- Few Terms
 - PLMN: Public Land Mobile Network
 - Home PLMN and visited PLMN
 - HLR
 - VLR

Handling mobility in cellular networks

- *Home network*: network of cellular provider you subscribe to (e.g., Airtel, Vodafone, Idea Cellular)
 - *Home location register (HLR)*: database in home n/w
 - Contains permanent cell phone #,
 - Profile info (services, preferences, billing),
 - Info about current location (could be in another network)
- *Visited network*: network in which MN currently resides
 - *Visitor location register (VLR)*: database with entry for each user currently in network
 - Could be home network
 - Contains info even when you are in home network
 - Generally, co-located with MSC
 - Co-ordinates call setup - to/from visited network

GSM: Indirect Routing to Mobile



Q: Return path?

Routing Calls to a Mobile User

- CN dials the number of MN
 - Leading digits of MN identifies the home network
 - Call is routed to home MSC of MN (first leg of call)
- MSC receives call, queries HLR for location of MN
- HLR returns MSRN (i.e. roaming number)
 - MSRN is different from MSISDN of MN
 - MSRN is similar to CoA in mobile IP
 - Similar to CoA, invisible to MN
- Home MSC sets up second leg of the call
 - Connects to MSC of visited network
 - Call is completed with connecting to BS where MN is.

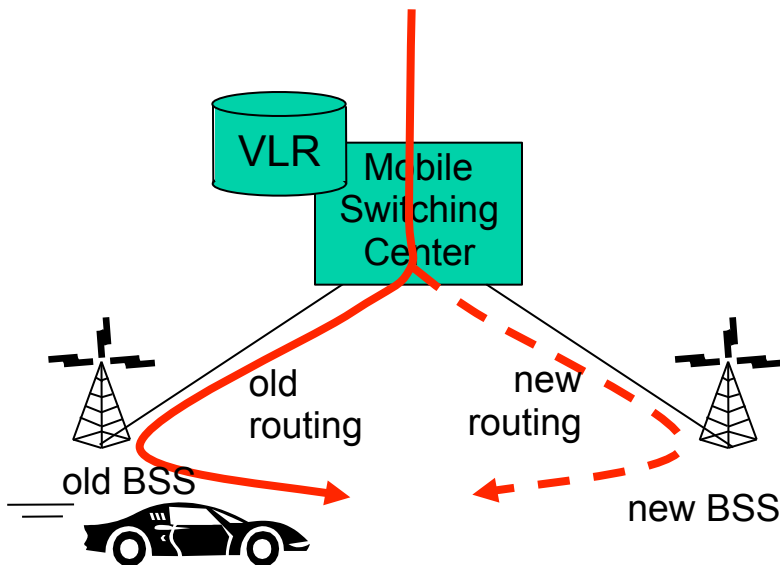
GSM: indirect routing to mobile

- How does HLR gets info about VLR
 - MS moves to visited network
 - MS registers itself with VLR
 - VLR sends LU (Location Update) msg to HLR
 - Contains either routing number (MSRN), or
 - VLR address
 - Used later to obtain MSRN
 - VLR also obtains the subscriber information
 - Which services can be offered to MS

GSM: handoff with common MSC

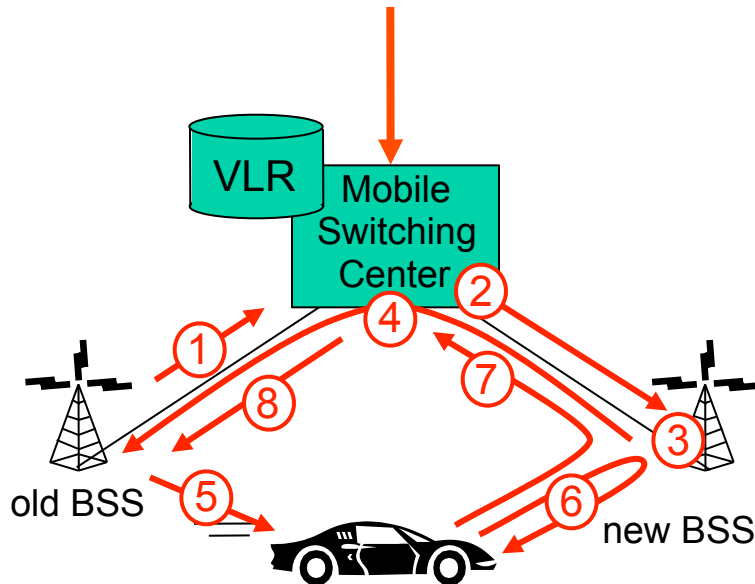
What is Handoff?

Change of BS association



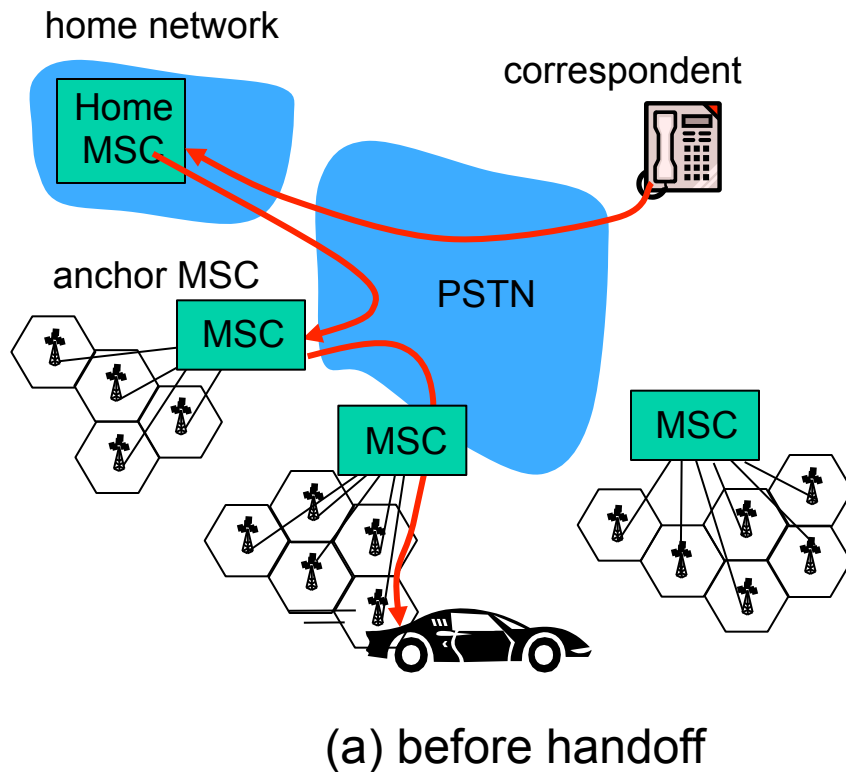
- *Handoff goal*: route call via new base station (without interruption)
- Reasons for handoff:
 - Stronger signal to/from new BSS (continuing connectivity, less battery drain)
 - Load balance: free up channel in current BSS
 - GSM doesn't mandate why to perform handoff (policy), only how (mechanism)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

GSM: handoff with common MSC



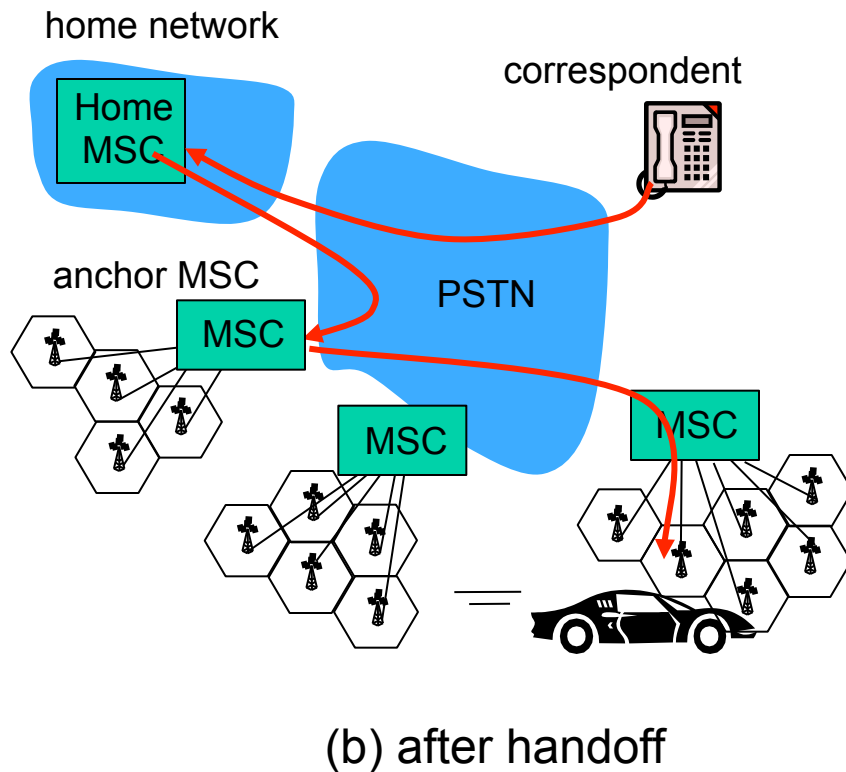
1. Old BSS informs MSC of impending handoff, provides list of 1+ new BSSs
2. MSC sets up path (allocates resources) to new BSS
3. New BSS allocates radio channel for use by mobile
4. New BSS signals MSC, old BSS: ready
5. Old BSS tells mobile: perform handoff to new BSS
6. Mobile, new BSS signal to activate 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
- Optional path minimization step to shorten multi-MSC chain

GSM: handoff between MSCs



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Mobility: GSM versus Mobile IP

GSM element	Comment on GSM element	Mobile IP element
Home system	Network to which mobile user's permanent phone number belongs	Home network
Gateway Mobile Switching Center, or "home MSC". Home Location Register (HLR)	Home MSC: point of contact to obtain routable address of mobile user. HLR: database in home system containing permanent phone number, profile information, current location of mobile user, subscription information	Home agent
Visited System	Network other than home system where mobile user is currently residing	Visited network
Visited Mobile services Switching Center. Visitor Location Record (VLR)	Visited MSC: responsible for setting up calls to/from mobile nodes in cells associated with MSC. VLR: temporary database entry in visited system, containing subscription information for each visiting mobile user	Foreign agent
Mobile Station Roaming Number (MSRN), or "roaming number"	Routable address for telephone call segment between home MSC and visited MSC, visible to neither the mobile nor the correspondent.	Care-of-address

Wireless, mobility: impact on higher layer protocols

- Logically, impact *should* be minimal ...
 - Changes are only in link layer
 - Best effort service model (IP layer) remains unchanged
 - TCP and UDP can (and do) run over wireless, mobile
- ... but performance-wise:
 - Packet loss/delay due to bit-errors (discarded packets, delays for link-layer retransmissions), and handoff
 - TCP interprets loss as congestion, will decrease congestion window un-necessarily
 - Delay impairments for real-time traffic
 - Limited bandwidth of wireless links

Wireless, mobility: impact on higher layer protocols

- Approaches for dealing with TCP Congestion
 - Local recovery
 - ARQ protocol, FEC for bit errors
 - TCP Sender aware of wireless links
 - Invokes congestion control only when
 - Loss is due to congestive wired network losses
- Split connection approaches
 - End to end connection is split into two parts
 - Mobile to Access Point
 - Access point to other communication end point
 - E-to-e connection is catenation of wired & wireless part

Wireless, mobility: impact on higher layer protocols

- Impact on application layer
 - Logically should have no impact
 - Reality: Consider a web server serving mobile on 3G
 - May not be able to provide content rich images
 - Mobility however opens another opportunity
 - Location aware services
 - Wireless n/w will play a key role in
 - Ubiquitous computing environment of the future
 - We are at tip of the iceberg

Summary - Mobility

- *Mobility*
- Principles: addressing, routing to mobile users
- Home, visited networks
- Direct, indirect routing
- Care-of-addresses
- Mobile IP
- Mobility in GSM
- Impact on higher-layer protocols

VTU Questions (2015 scheme)

- July 2019 - Q7
 - Illustrate the two different approaches for routing to a mobile node (8 marks)
 - With a neat diagram, bring out the steps for mobile node registration to home agent. (8 marks)
- July 2019 - Q8
 - Bring out the components of 3G cellular network architecture (8)
 - State handoff? What are the steps involved in accomplishing handoff (5 marks)
 - Explain the three phases of mobile IP (3 marks)
- Jan 2019 - Q7
 - Explain components of cellular network architecture (8 marks)
 - Explain direct routing of a mobile node (8 marks)
- Jan 2019 - Q8
 - Explain steps of handoff a mobile user (8 marks)
 - Explain HLR, VLR, Home Address, Care of address (8 marks)

VTU Questions (2015 scheme)

- July 2018 - Q7
 - Define cellular network. Give the overview of GSM cellular network architecture (8 marks)
 - Explain the two different types of routing approaches to mobile node (8 marks)
- July 2018 - Q8
 - Explain the following concepts of mobile IP (8 marks)
 - a. Agent discovery, b) Registration with home agent
 - Illustrate the steps involved when a base station does decide to hand-off a mobile user IP (8 marks)

VTU Questions (2015 scheme)

–Jan 2018 - Q7

- Show the components of GSM 2G Cellular network architecture with a diagram (7 marks)
- Illustrate the steps involved in mobile IP registration with home agent (5)
- Write a note on mobile IP (4 marks)

–Jan 2018 - Q8

- Define handoff. Explain the steps accomplishing a handoff. (7 marks)
- Bring out the mechanism of direct routing to mobile node in mobility management. (6 marks)
- Compare the 4G LTE standard to 3G systems. (3 marks)