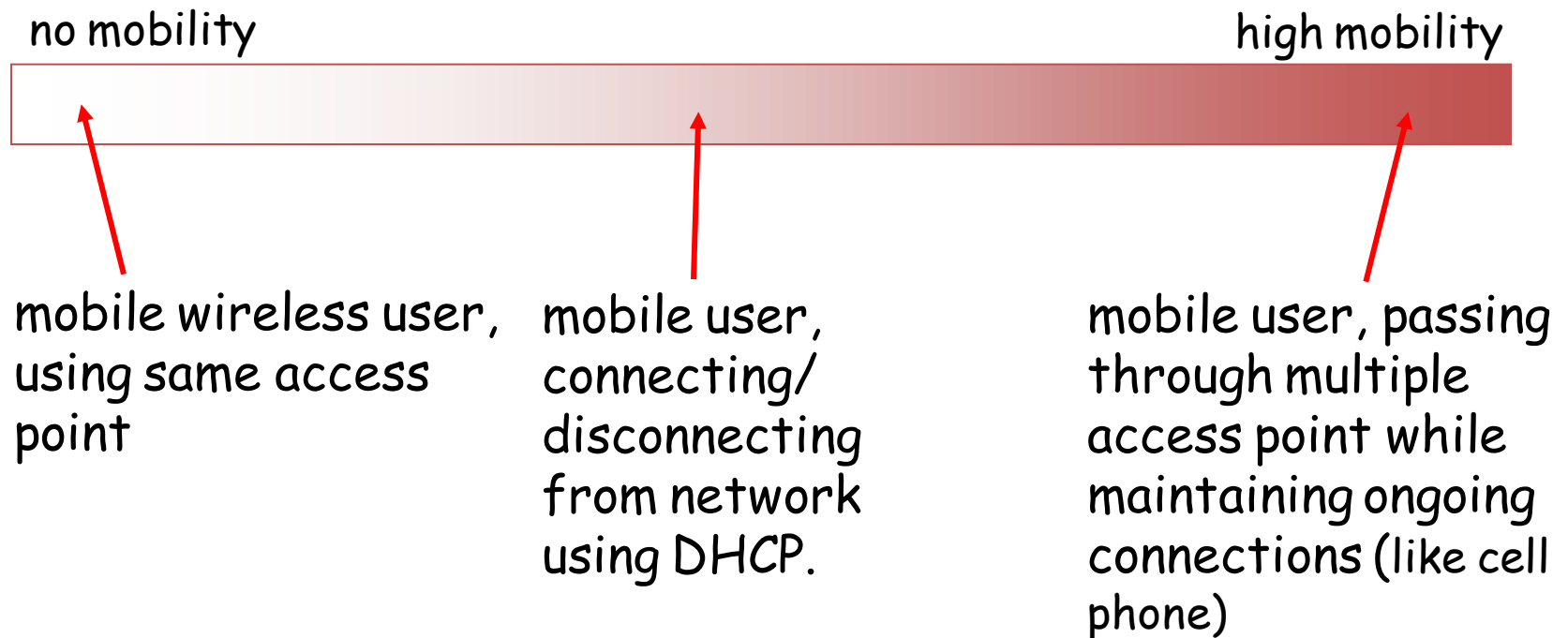


Wireless Internet Routing

Mobile IP and Mobile Routing

What is mobility?

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

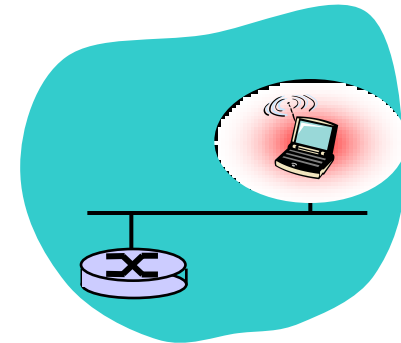
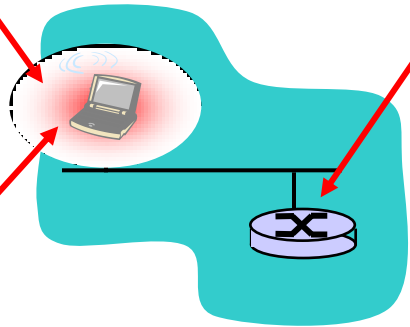


Mobility: Vocabulary

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

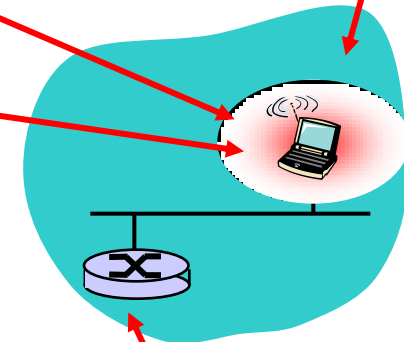
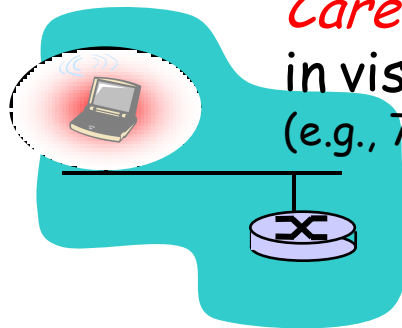


Mobility: more vocabulary

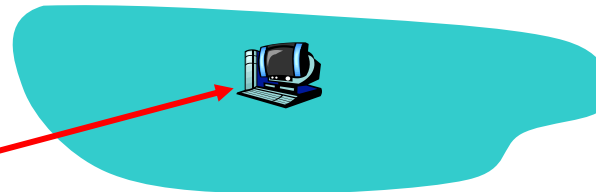
Permanent address: remains constant (e.g., 128.119.40.186)

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?

I wonder where Alice moved to?



- Search all phone books
- Call her parents?
- Expect her to let you know where he/she is?



Mobility: approaches

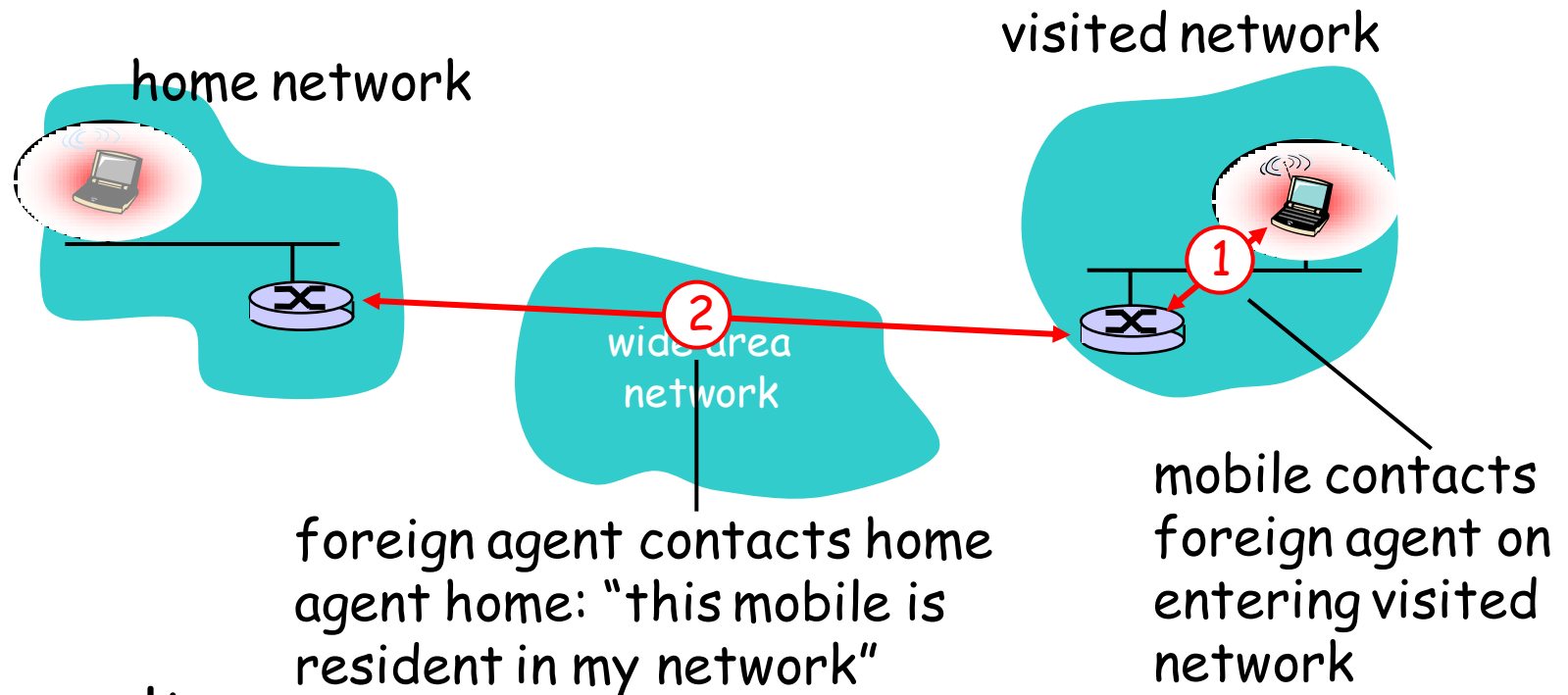
- ❑ *Let routing handle it:* routers advertise permanent address of mobile-nodes-in-residence via usual routing table exchange.
 - Routing tables indicate where each mobile located
 - No changes to end-systems
- ❑ *Let end-systems handle it:*
 - *Indirect routing:* communication from correspondent to 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:* routers advertise permanent address of mobile, mobile changes residence via usual routing table exchange
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not
scalable
to millions of
mobiles

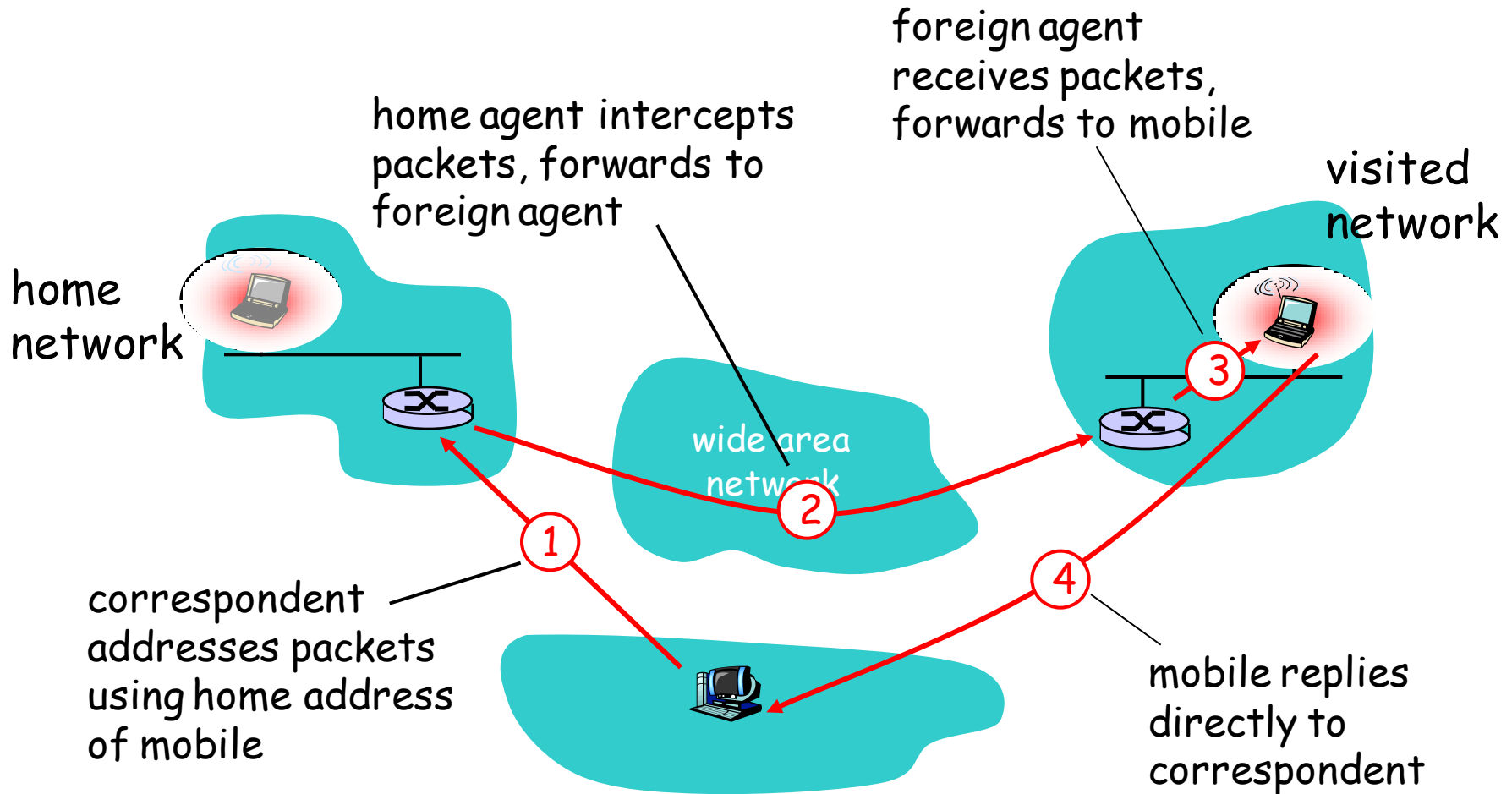
Mobility: registration



End result:

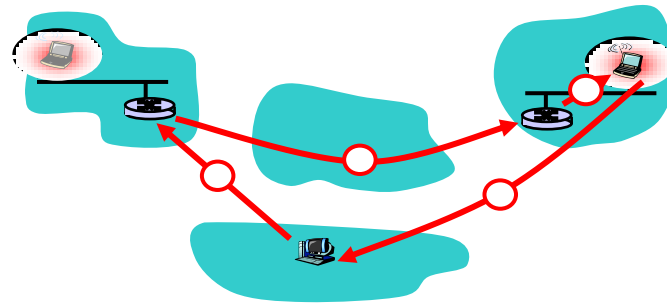
- Foreign agent knows about mobile
- Home agent knows location of mobile

Mobility via Indirect Routing



Indirect Routing: comments

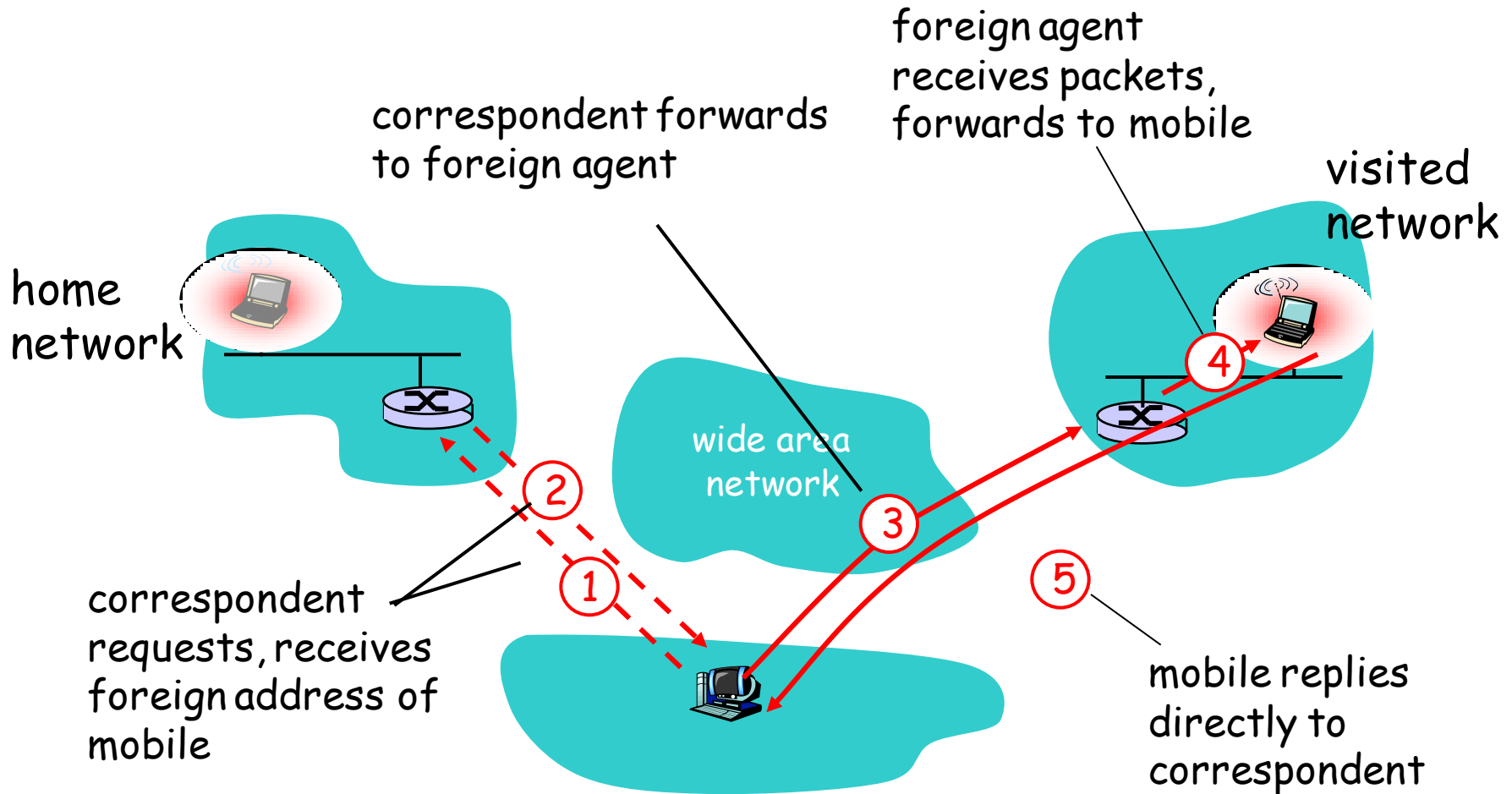
- ❑ Mobile uses two addresses:
 - **Permanent address:** used by correspondent (hence mobile location is *transparent* to correspondent)
 - **Care-of-address:** used by home agent to forward datagrams to mobile
- ❑ Foreign agent functions may be done by mobile itself
- ❑ **Triangle routing:** correspondent-home-network-mobile
 - Inefficient when correspondent, mobile are in same network



Indirect Routing: moving between networks

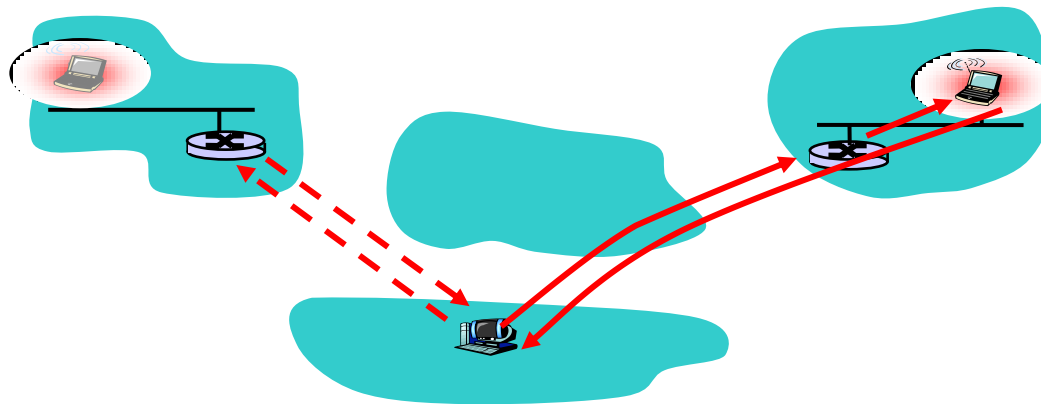
- Suppose mobile user moves to another network
 - Registers with new foreign agent
 - New foreign agent registers with home agent
 - Home agent update care-of-address for mobile
 - Packets continue to be forwarded to mobile (but with new care-of-address)
- Mobility, changing foreign networks transparent: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

Mobility via Direct Routing



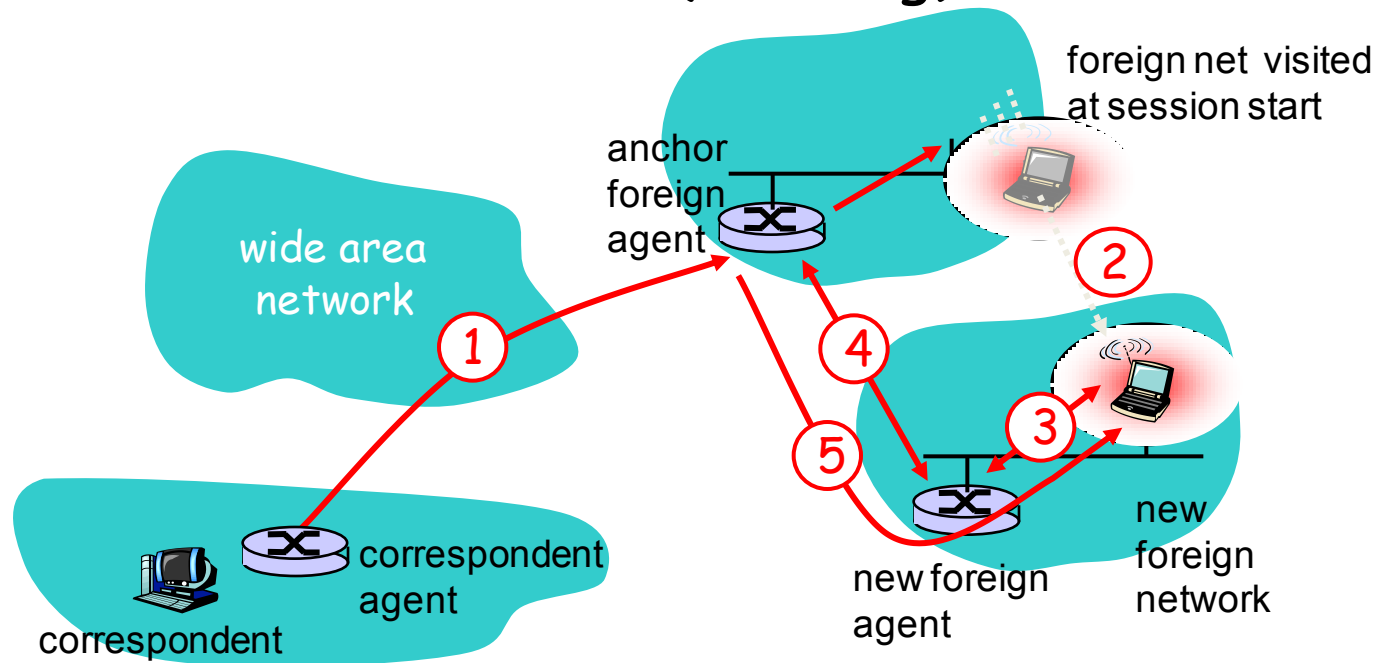
Mobility via Direct Routing: comments

- ❑ 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)



Mobile IP

□ RFC 3344

- Updates in RFC 4721. Mobile IPv6: RFC 3775

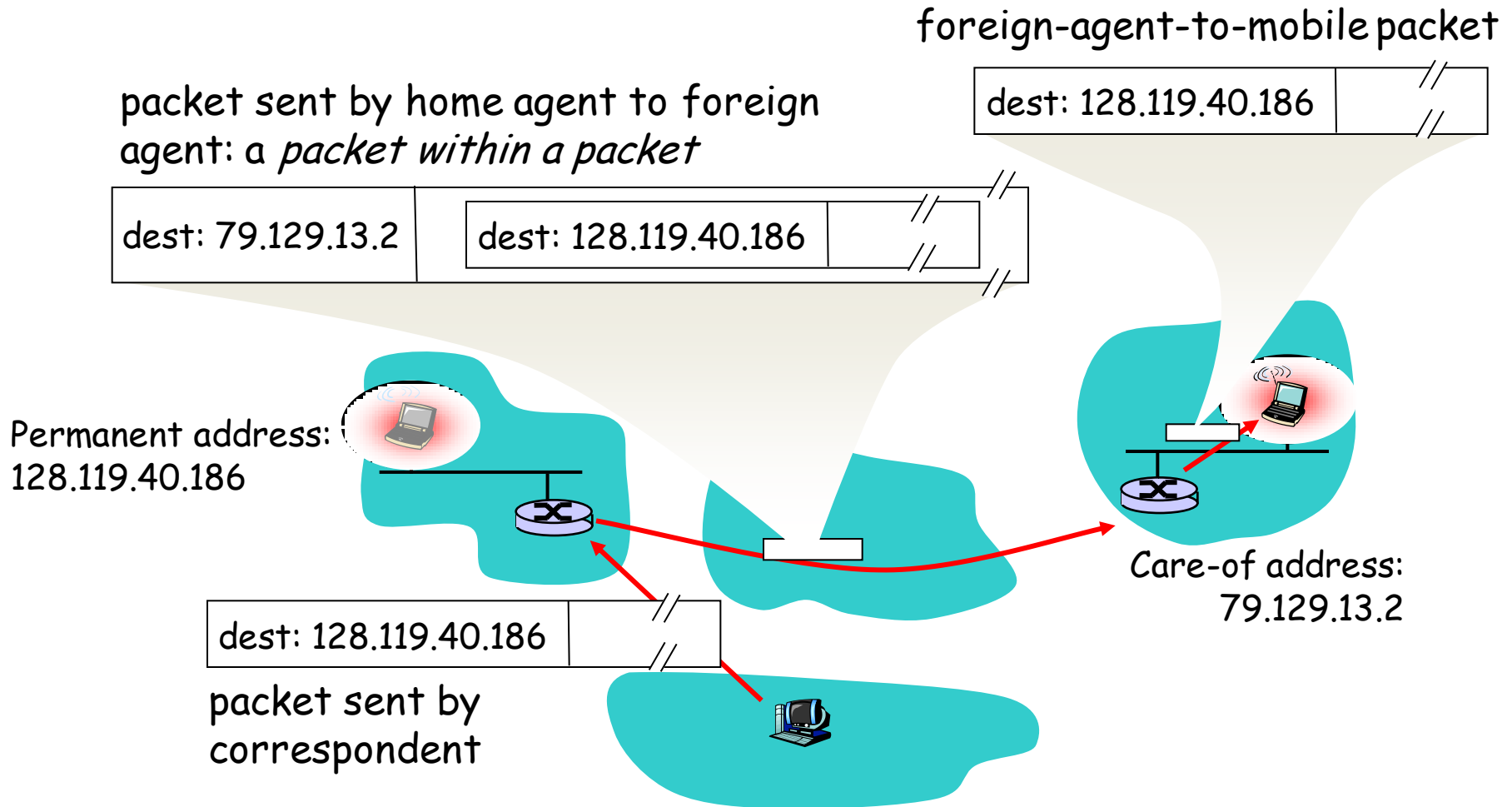
□ Many features we've seen:

- Home agents, foreign agents, foreign-agent registration, care-of-addresses, encapsulation (packet-within-a-packet)

□ Three components to standard:

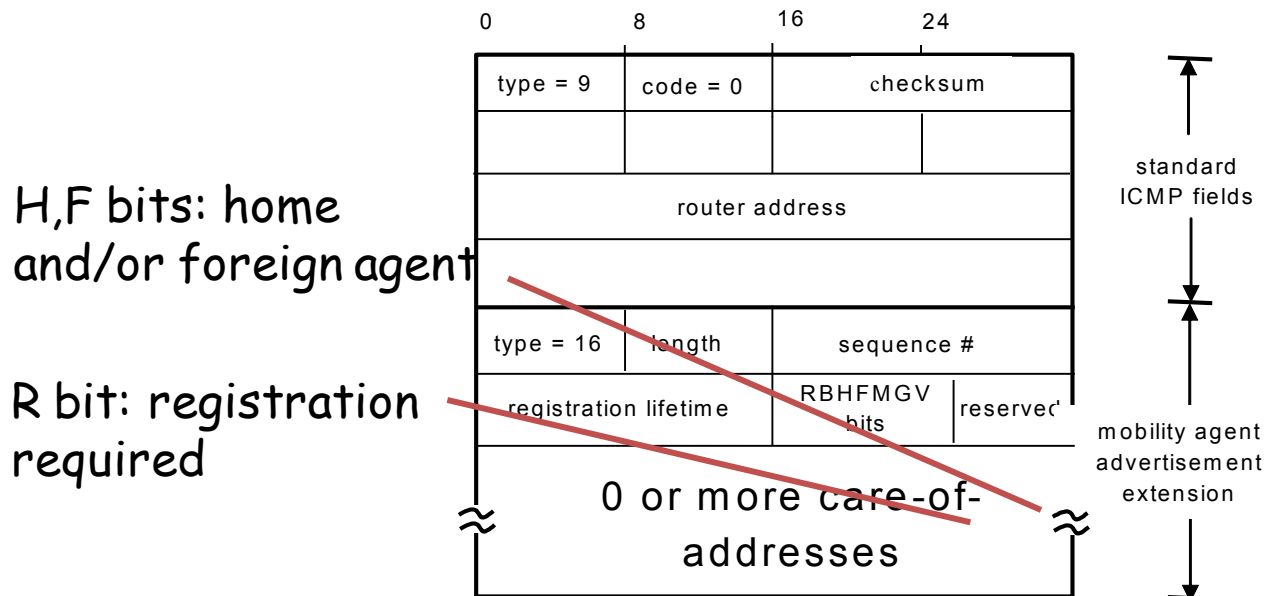
- Indirect routing of datagrams
- Agent discovery
- Registration with home agent

Mobile IP: indirect routing

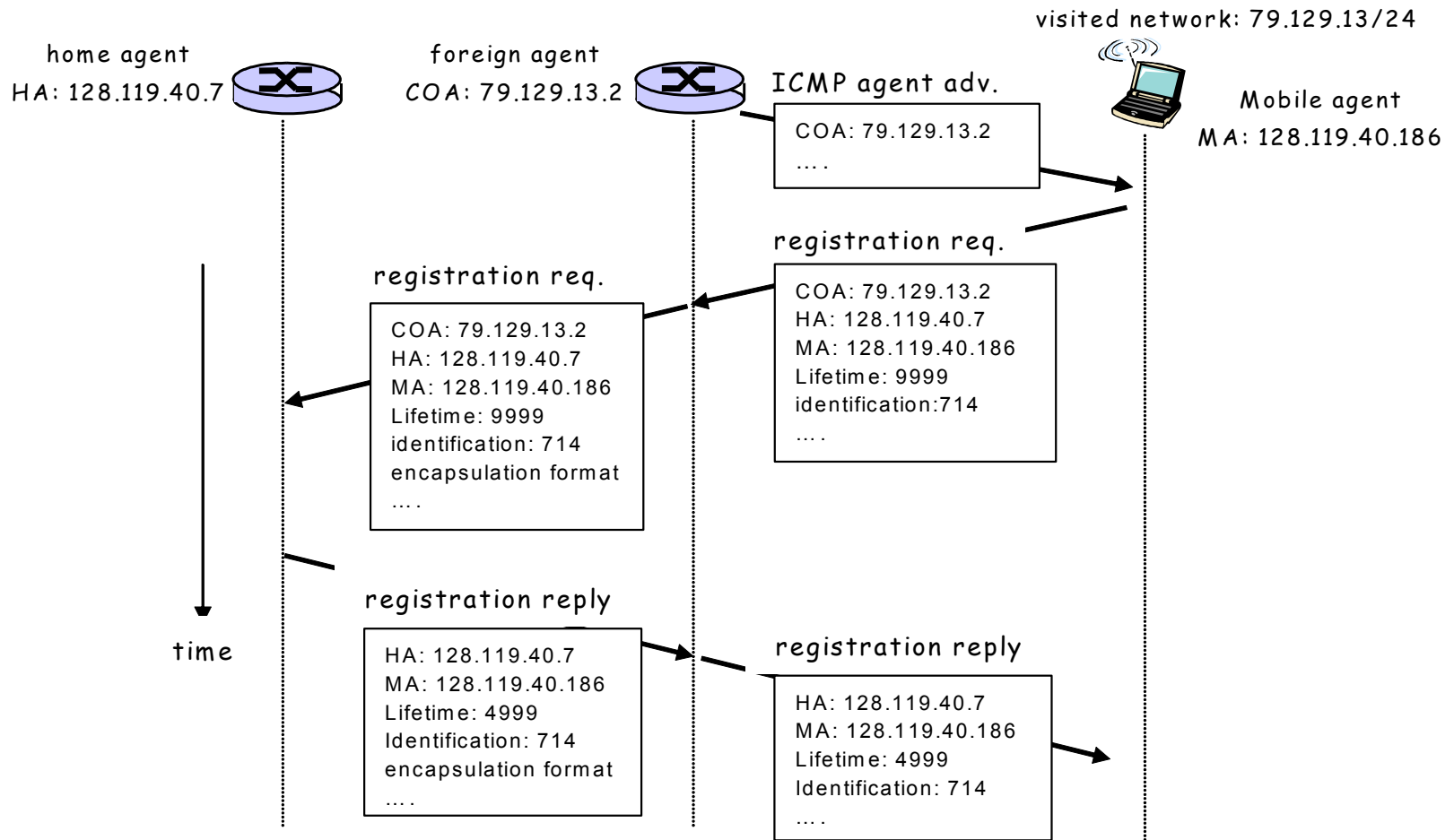


Mobile IP: agent discovery

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



Mobile IP: registration example



Wireless, mobility: impact on higher layer protocols

- ❑ Logically, impact *should* be minimal ...
 - Best effort service model 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