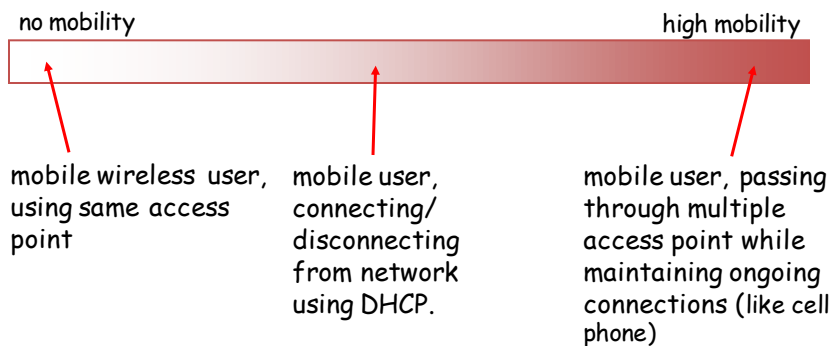


# Wireless Internet Routing

## 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

wide area network

correspondent

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## 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)

wide area network

**correspondent:** wants to communicate with mobile

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

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## 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?



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## 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

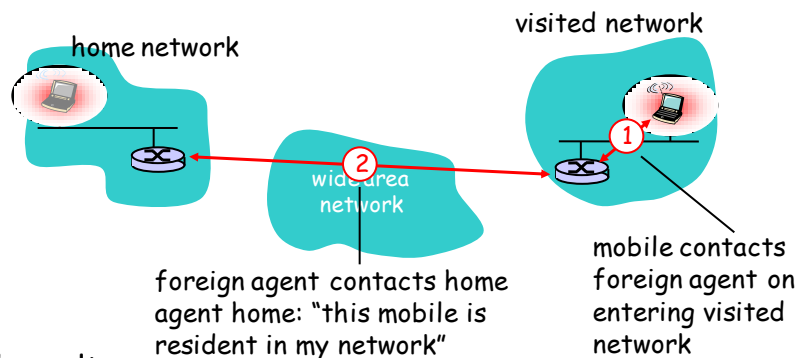
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## Mobility: approaches

- Let routing handle it:* routers advertise permanent address of mobile, routers advertise permanent residence via usual routing table exchange
  - o Routing tables include address of each mobile located
  - o No changes to end-systems
- let end-systems handle it:*
  - o *Indirect routing:* communication from correspondent to mobile goes through home agent, then forwarded to remote
  - o *Direct routing:* correspondent gets foreign address of mobile, sends directly to mobile

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## Mobility: registration

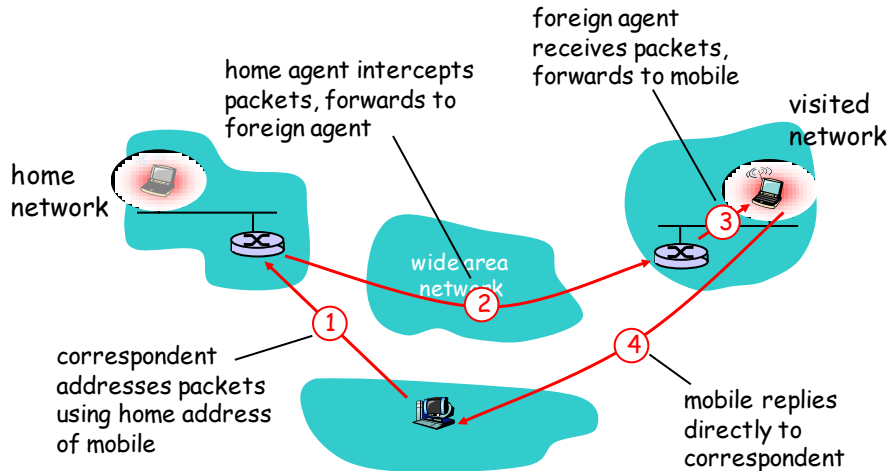


End result:

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

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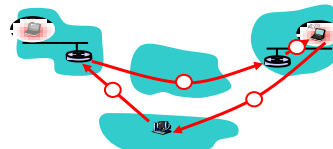
## Mobility via Indirect Routing



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## 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



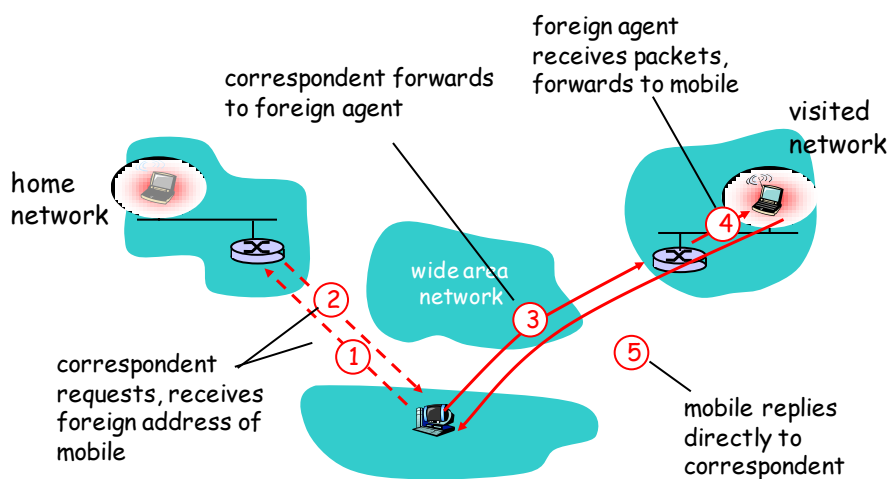
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## Indirect Routing: moving between networks

- 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!*

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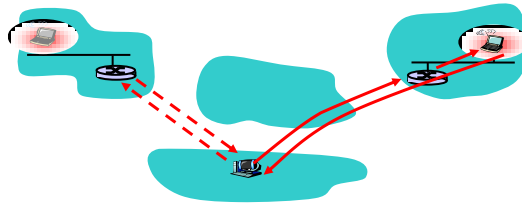
## Mobility via Direct Routing



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## Mobility via Direct Routing: comments

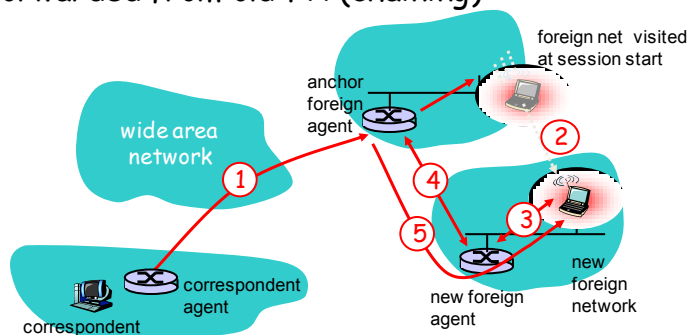
- ❑ Overcome triangle routing problem
- ❑ **Non-transparent to correspondent:** correspondent must get care-of-address from home agent
  - What if mobile changes visited network?



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## 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)



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## Mobile IP

### □ RFC 3344

- Updates in RFC 4721. Mobile IPv6: RFC 3775

### □ Many features we've seen:

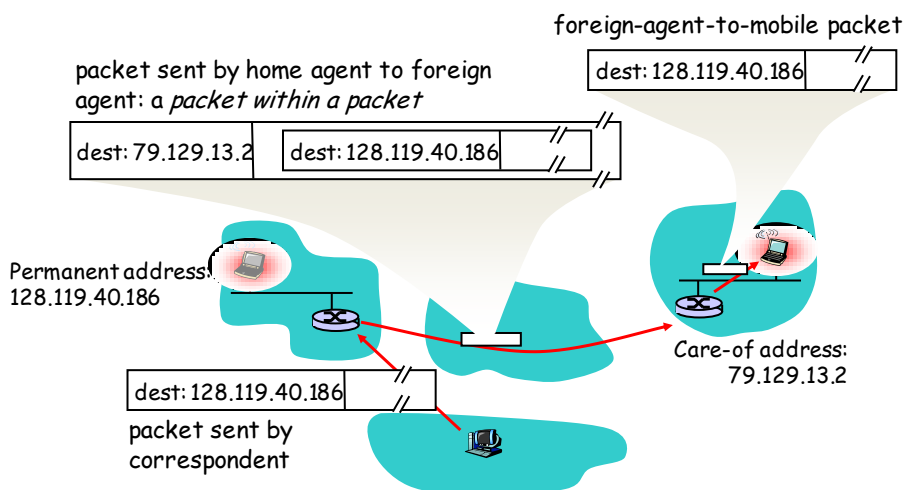
- Home agents, foreign agents, foreign-agent registration, care-of-addresses, encapsulation (packet-within-a-packet)

### □ Three components to standard:

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

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## Mobile IP: indirect routing

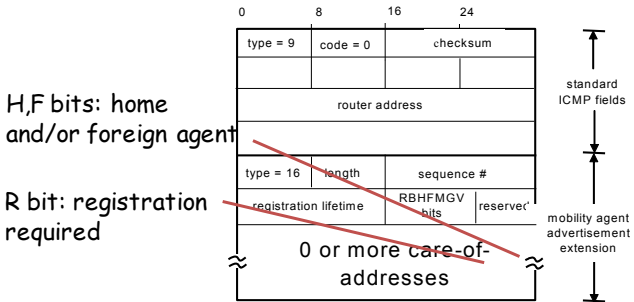


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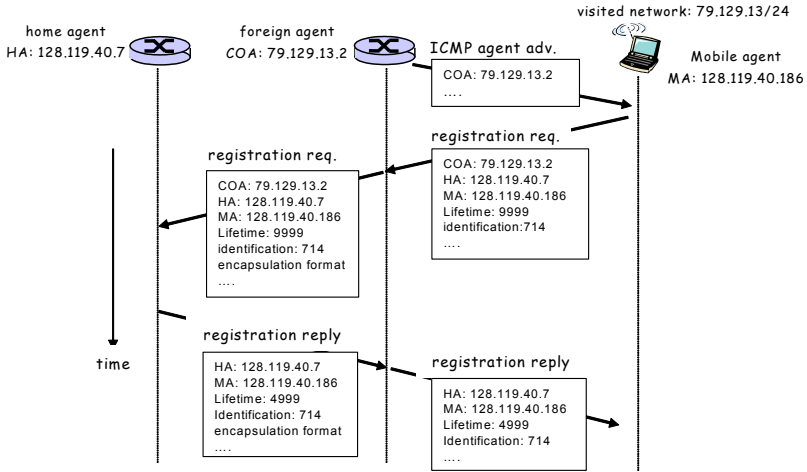


# Mobile IP: agent discovery

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



# Mobile IP: registration example



## Locator Identifier Separation

- IP address has two functions:
  - Identifier
  - Locator for routing
- Can we separate these functions? How?

## 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