Distance vector algorithm

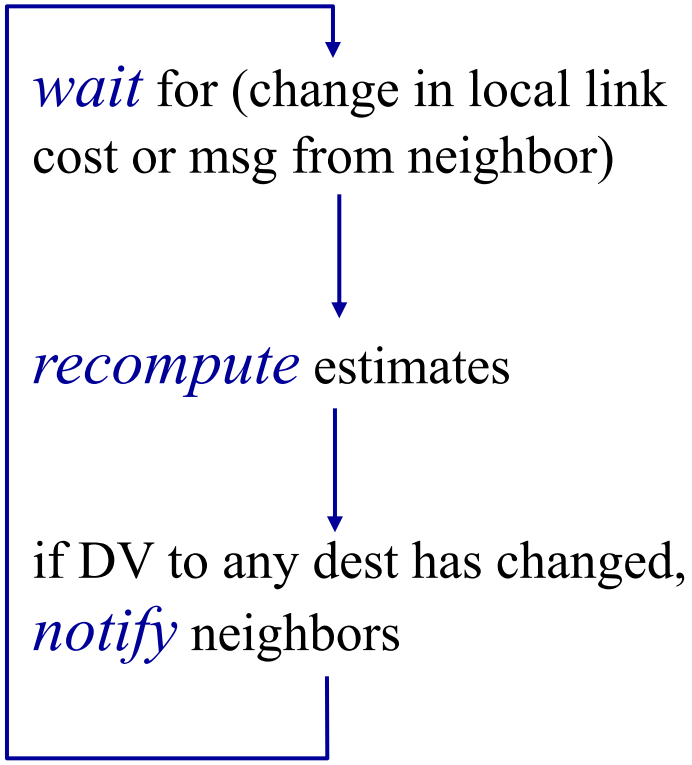
iterative, asynchronous:
each local iteration caused by:

- local link cost change
- DV update message from neighbor

distributed:

- each node notifies neighbors *only* when its DV changes
  - neighbors then notify their neighbors if necessary

each node:



$D_y(x)=\min\{c(y,x)+D_x(x), c(y,z)+D_z(x)\}$

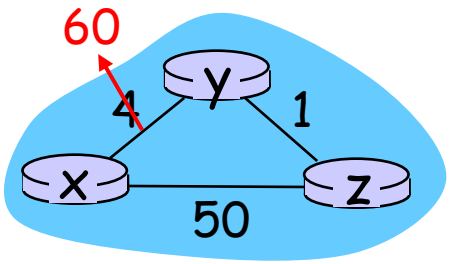
$D_z(x)=\min(c(z,x)+D_x(x), c(z,y)+D_y(x))$

node x table

from \ cost to	x	y	z
x	0	4	~~5~~ 50
y	4	0	1
z	5	1	0

from \ cost to	x	y	z
x			
y			
z			

from \ cost to	x	y	z
x			
y			
z			



Detect c(x,y)=c(y,x)=60 !

node y table

from \ cost to	x	y	z
x	0	4	5
y	~~4~~ 6	0	1
z	5	1	0

from \ cost to	x	y	z
x	0	51	50
y	6	0	1
z	5	1	0

from \ cost to	x	y	z
x	0	51	50
y	8	0	1
z	7	1	0

node z table

from \ cost to	x	y	z
x	0	4	5
y	4	0	1
z	5	1	0

from \ cost to	x	y	z
x	0	51	50
y	6	0	1
z	7	1	0

from \ cost to	x	y	z
x			
y			
z			

time

loop will persist for 44 iterations until z eventually computes the cost of its path via y to be greater than 50.

Poisoned reverse:

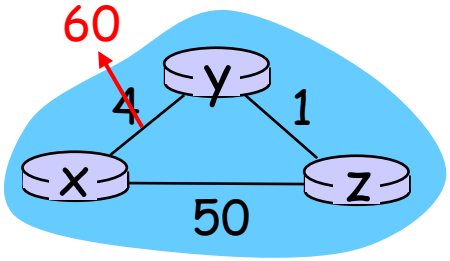
- If Z routes through Y to get to X :
  - Z tells Y its (Z's) distance to X is infinite (so Y won't route to X via Z)

node x table

from \ cost to	x	y	z
x	0	4	5 → 50
y	4	0	1
z	5	1	0

from \ cost to	x	y	z
x			
y			
z			

from \ cost to	x	y	z
x			
y			
z			



Detect c(x,y)=c(y,x)=60 !

node y table

from \ cost to	x	y	z
x	0	4	∞
y	4 → 60	0	1
z	∞	1	0

from \ cost to	x	y	z
x	0	51	50
y	6	0	1
z	5	1	0

from \ cost to	x	y	z
x	0	51	50
y	51	0	1
z	50	1	0

node z table

from \ cost to	x	y	z
x	0	4	5
y	4	0	1
z	5	1	0

from \ cost to	x	y	z
x	0	51	50
y	60	0	1
z	50	1	0

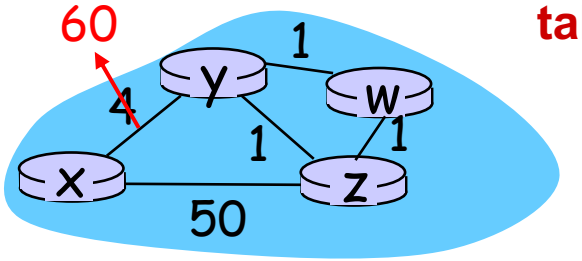
from \ cost to	x	y	z
x			
y			
z			

time

will this completely solve count to infinity problem?

No, when the loops involves three or more nodes

Distance vector: link cost changes



node x table

from \ cost to	x	y	z	w
x	0	4	5	5
y	4	0	1	1
z	5	1	0	1

node y table

from \ cost to	x	y	z	w
x	0	4	∞	∞
y	4	0	1	1
z	∞	1	0	1
w	∞	1	1	0

60

node z table

from \ cost to	x	y	z	w
x	0	4	5	5
y	4	0	1	1
z	5	1	0	1
w	5	1	1	0

node z table

from \ cost to	x	y	z	w
x	0	4	5	5
y	60	0	1	1
z	6	1	0	1
w	5	1	1	0

node w table

from \ cost to	x	y	z	w
x				
y	60	0	1	1
z	5	1	0	1
w	6	1	1	0

node w table

from \ cost to	x	y	z	w
y	4	0	1	1
z	5	1	0	1
w	5	1	1	0

node y table

from \ cost to	x	y	z	w
x	0	4	∞	∞
y	7	0	1	1
z	6	1	0	1
w	6	1	1	0

- Knows only one-hop neighbors' information
- Sends infinity to only the first-hop node along the path

Chapter 7 outline

7.1 Introduction

Wireless

7.2 Wireless links, characteristics

- CDMA

7.3 IEEE 802.11 wireless LANs (“Wi-Fi”)

7.4 Cellular Internet Access

- architecture
- standards (e.g., 3G, LTE)

Mobility

7.5 Principles: addressing and routing to mobile users

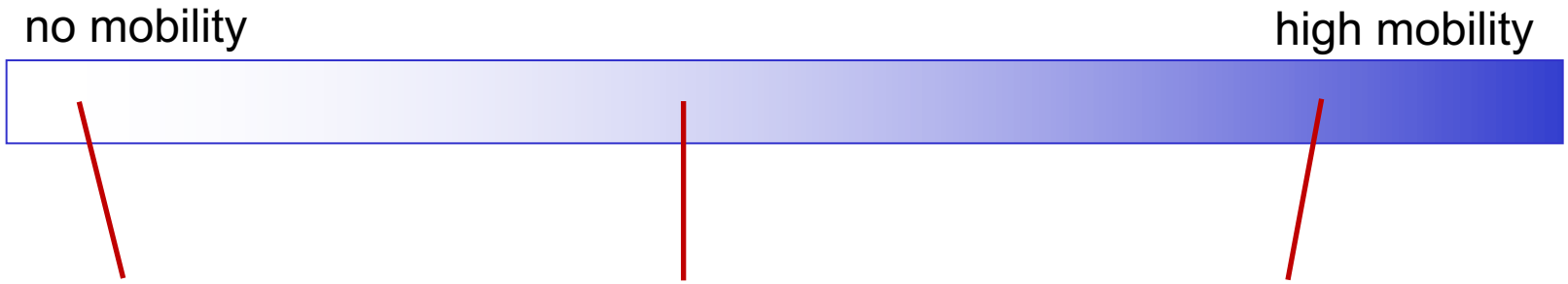
7.6 Mobile IP

7.7 Handling mobility in cellular networks

7.8 Mobility and higher-layer protocols

What is mobility?

Spectrum of mobility, from the *network* perspective:



mobile wireless user, using same access point

mobile user, connecting/ disconnecting from network using DHCP.

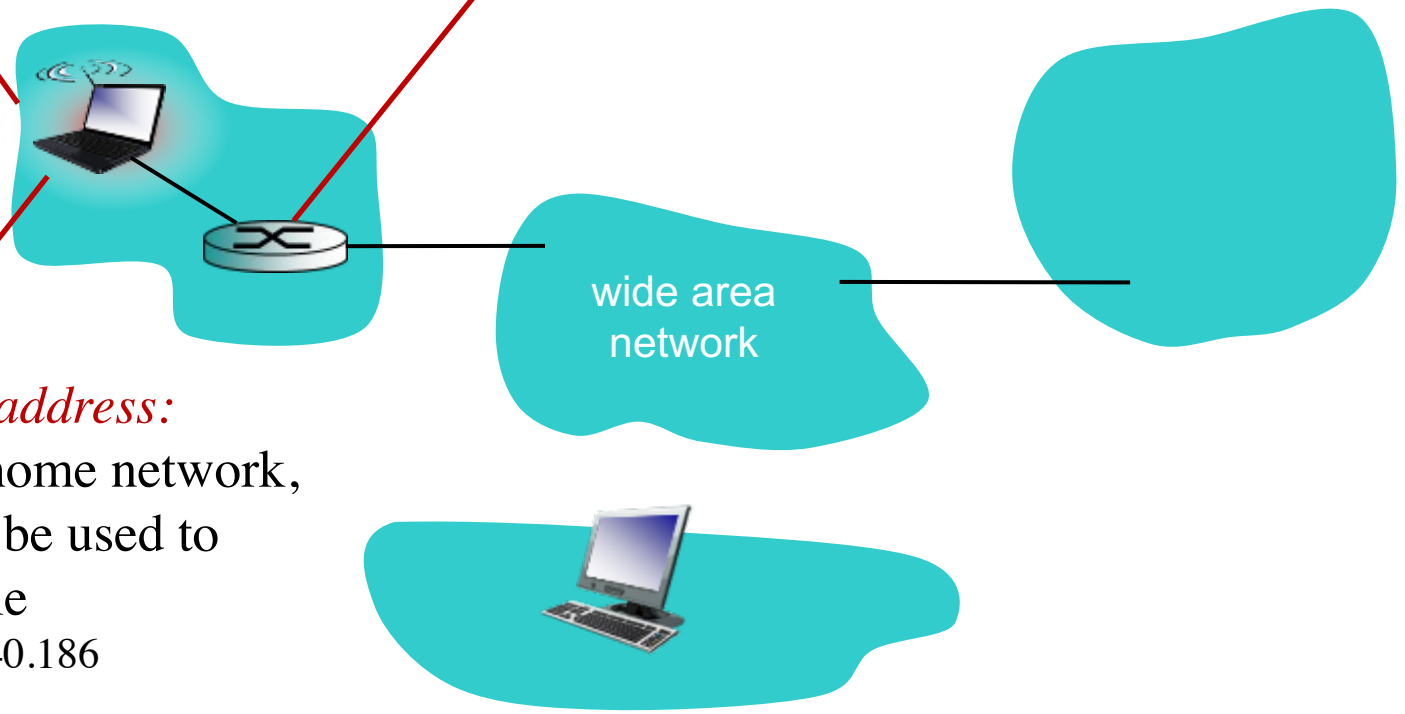
That is, shutting down while moving between networks.

mobile user, passing through multiple access point while maintaining ongoing connections (like cell phone)

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



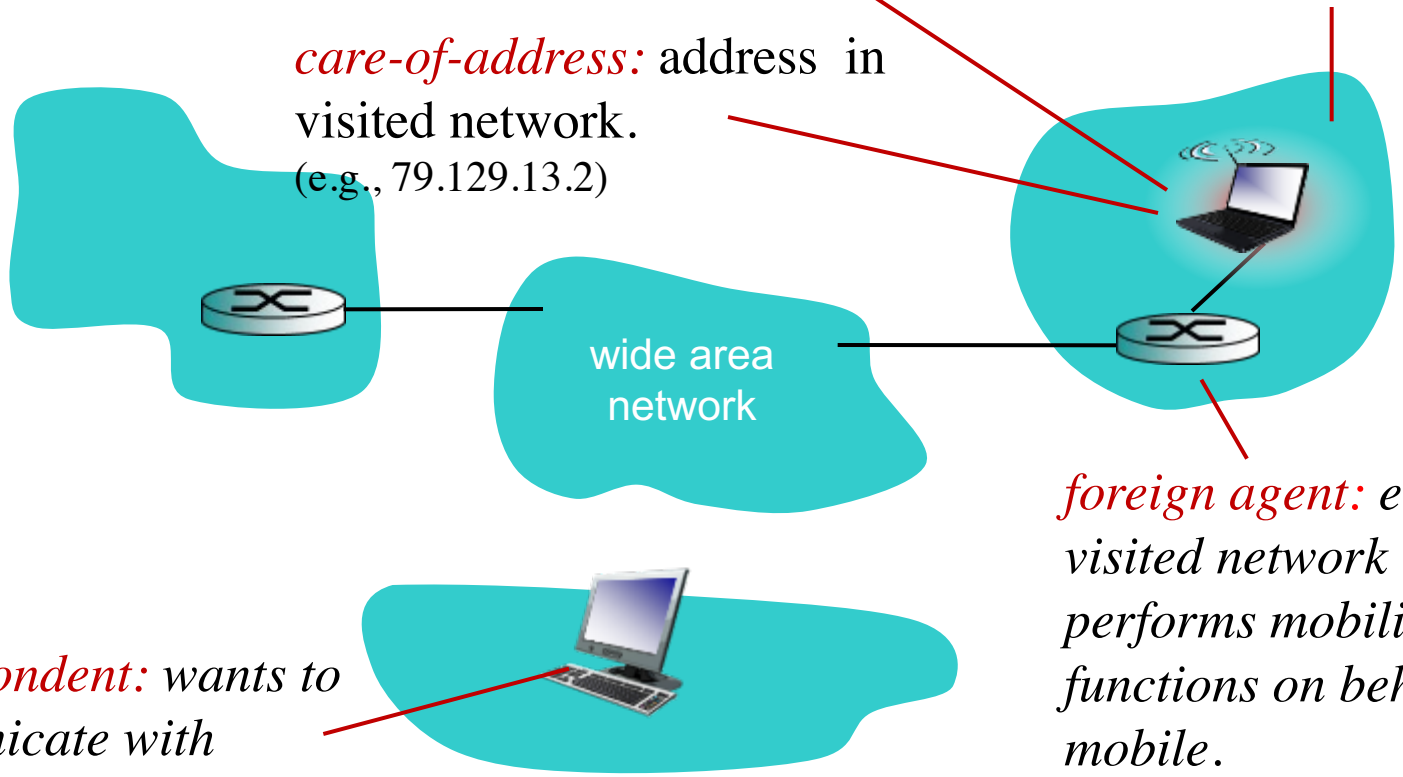
permanent address: address in home network, *can always* be used to reach mobile e.g., 128.119.40.186

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)



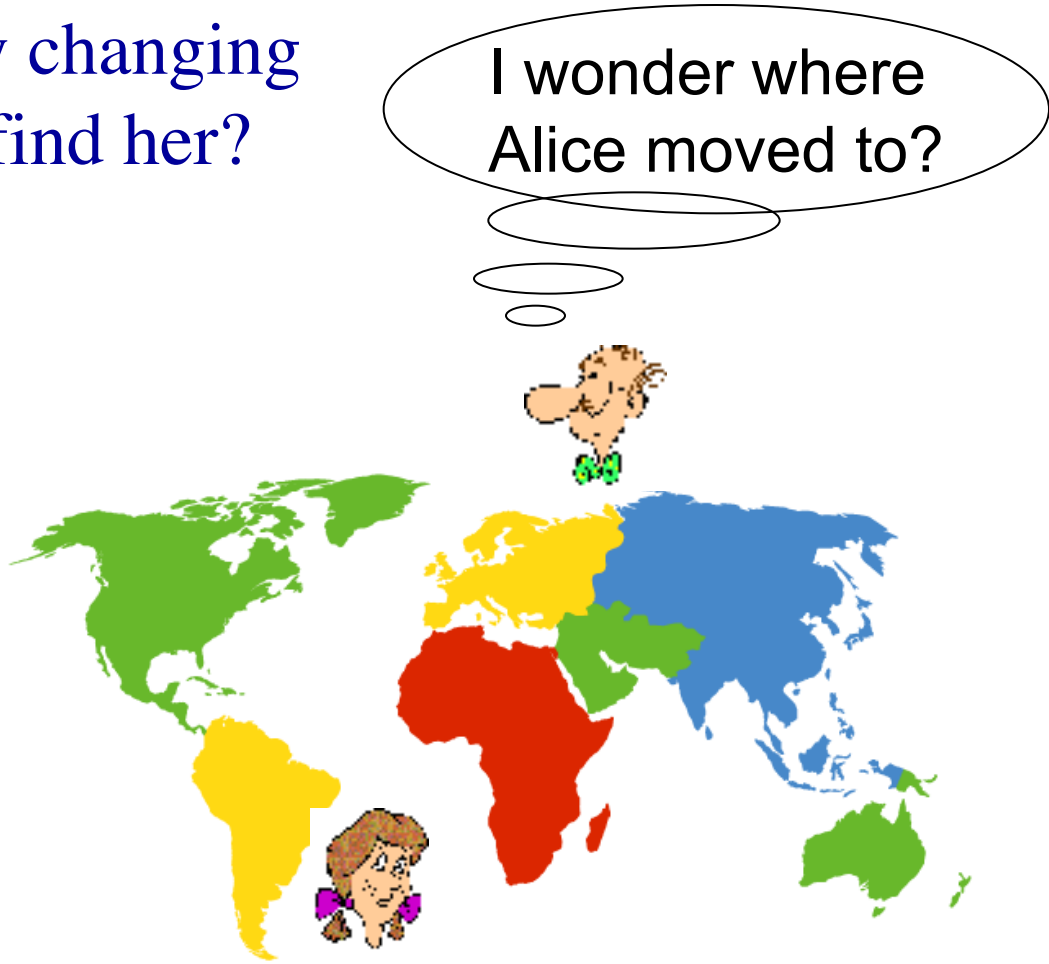
foreign agent: *entity in visited network that performs mobility functions on behalf of mobile.*

correspondent: *wants to communicate with 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?
- Facebook!



Mobility: approaches

- *let routing handle it:* foreign agent advertises 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-node-in-residence via usual routing table exchange
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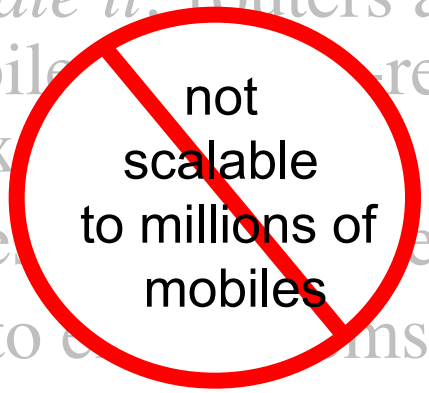
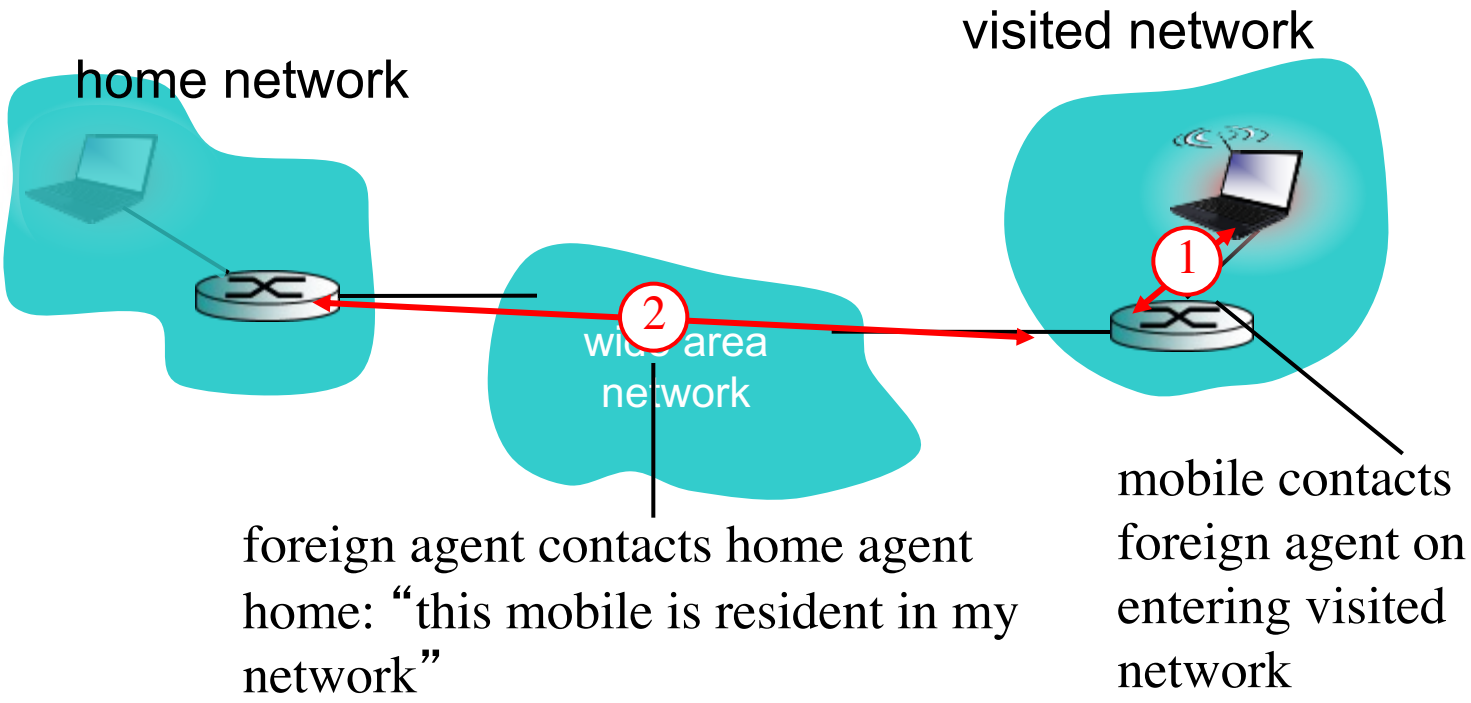


Mobility: registration

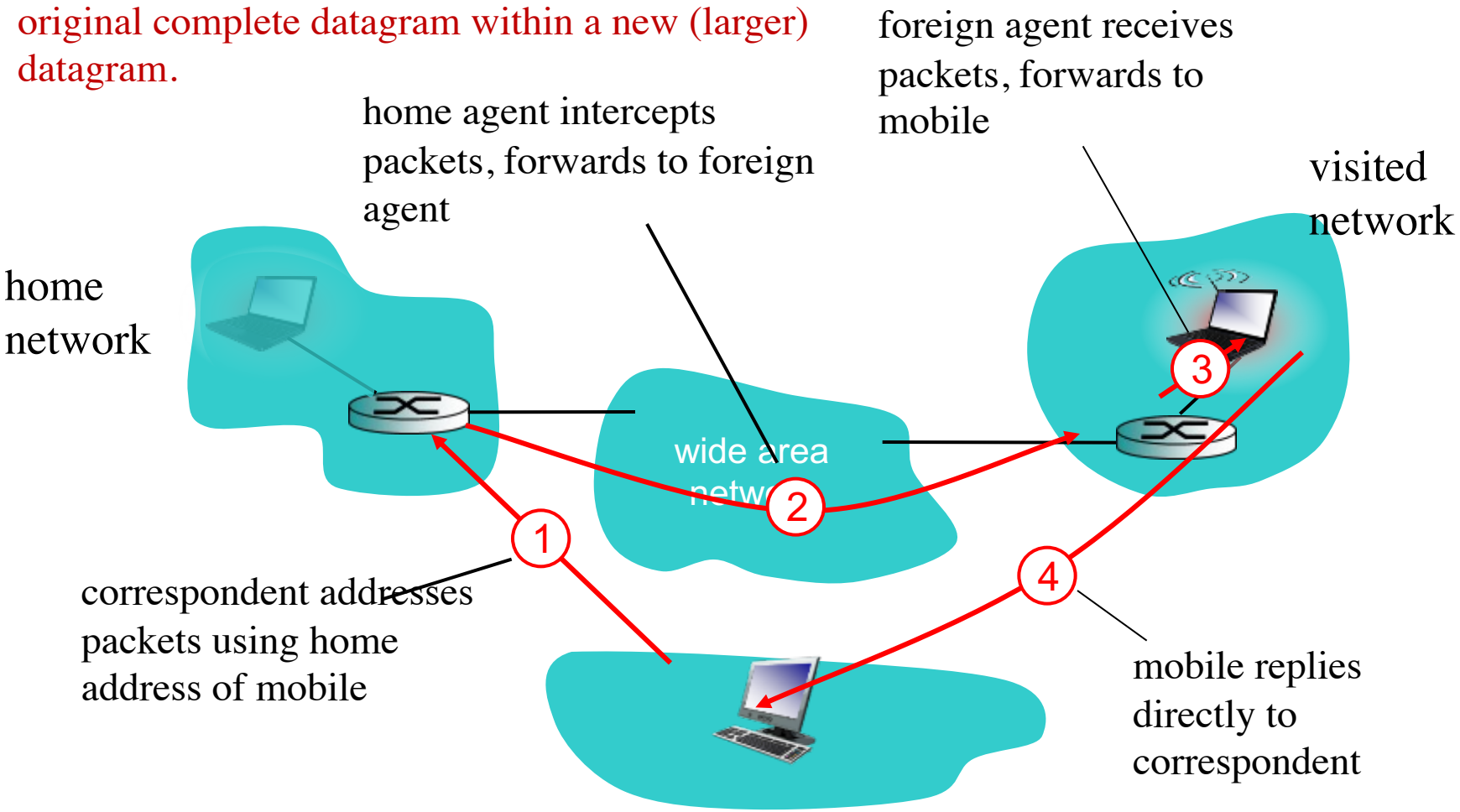


end result:

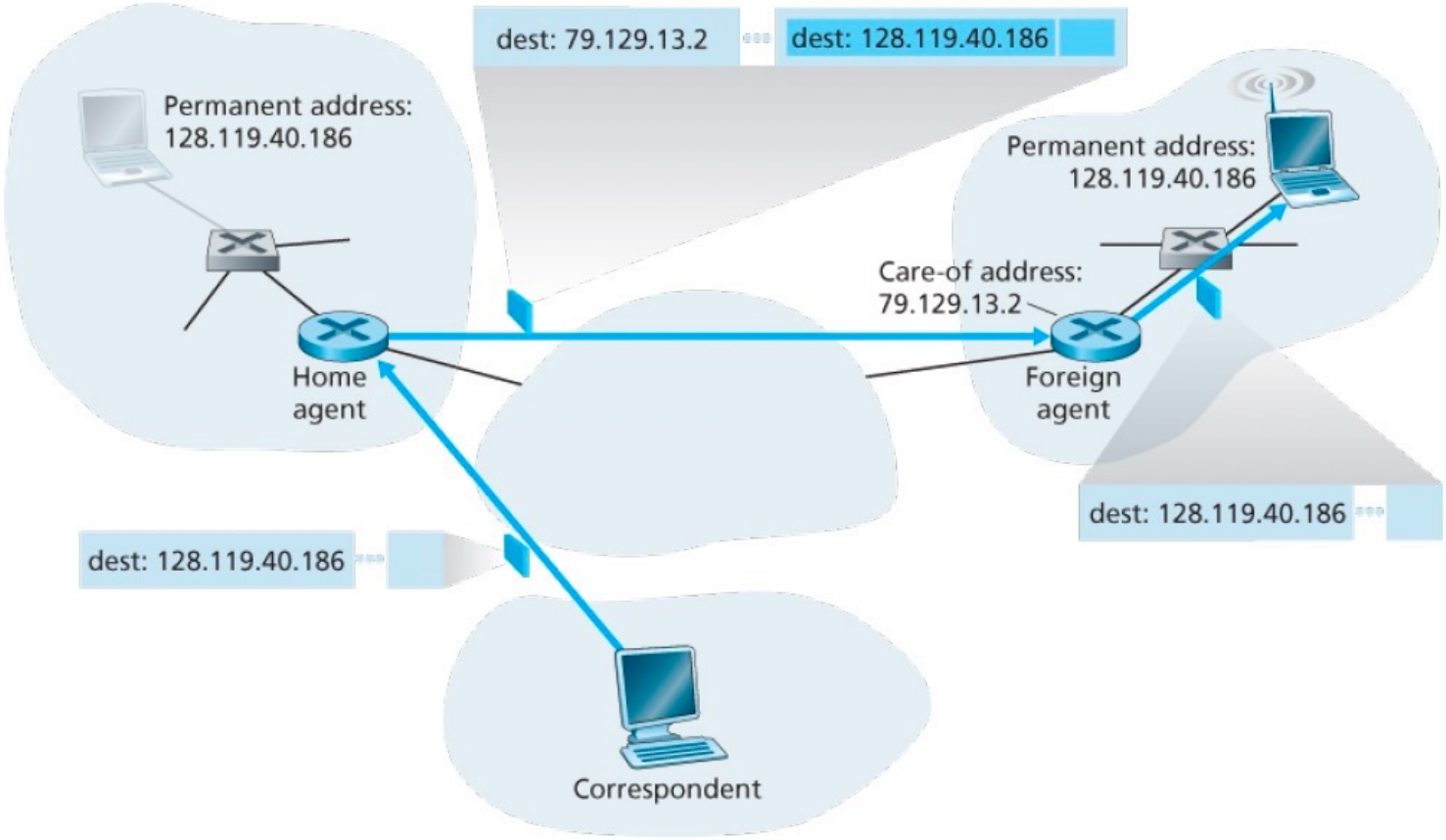
- foreign agent knows about mobile
- home agent knows location of mobile

Mobility via indirect routing

the home agent encapsulates the correspondent's original complete datagram within a new (larger) datagram.

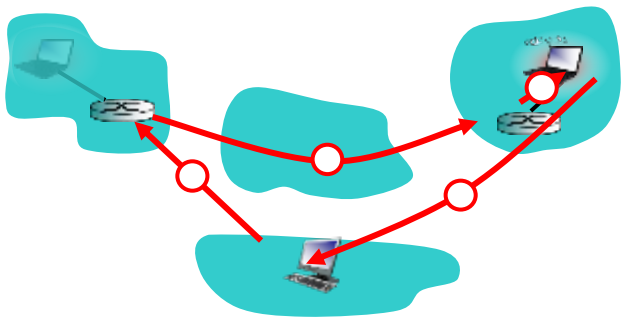


Mobility via indirect routing



Indirect Routing: comments

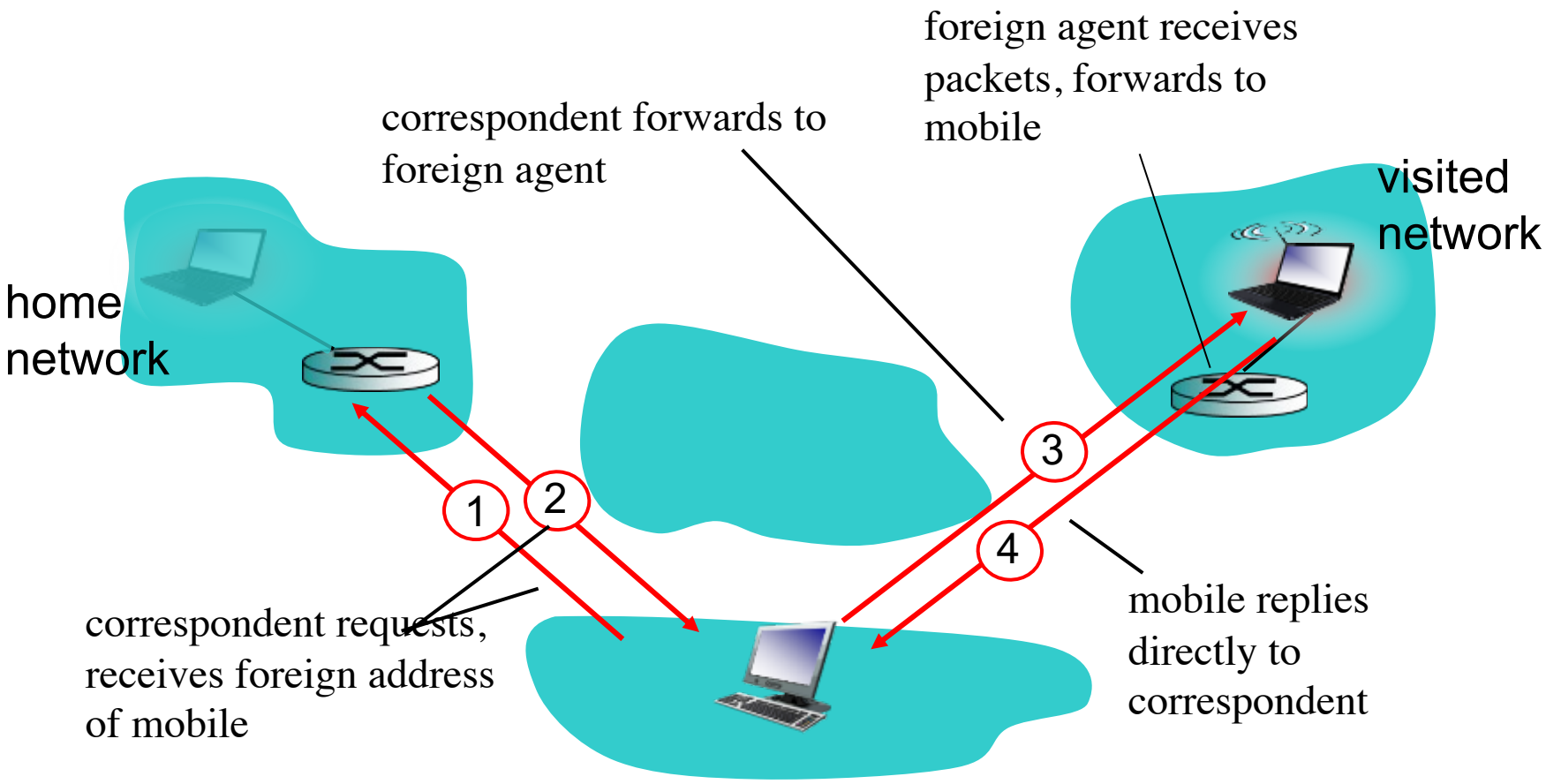
- mobile uses two addresses:
  - permanent address: used by correspondent (hence mobile location is *transparent* to correspondent)
  - care-of-address: used by home agent to forward datagrams to mobile
- foreign agent functions may be done by mobile itself
- triangle routing: correspondent-home-network-mobile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



Indirect routing: moving between networks

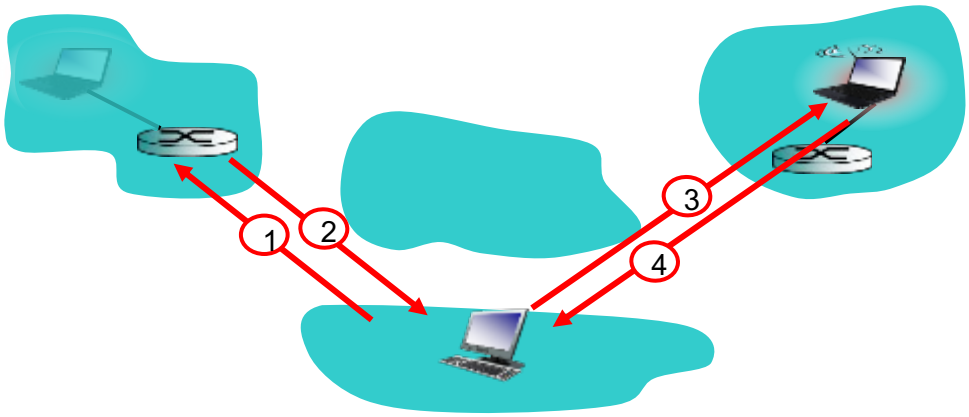
- suppose mobile user moves to another network
  - registers with new foreign agent
  - new foreign agent registers with home agent
  - home agent update care-of-address for mobile
  - packets continue to be forwarded to mobile (but with new care-of-address)
- mobility, changing foreign networks transparent: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