University of Hertfordshire

7COM1076 Wireless Mobile & Multimedia Networking

Mobile IP (part 1)

Dr Tazeen Syed

t.s.syed@herts.ac.uk

School of Physics Engineering and Computer Science (SPECS)

Outline

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What is Mobile IP

- Mobile IP is a protocol defined by the Internet Engineering task Force (IETF) that enables mobile device users whose IP addresses are associated with one network to retain the same IP address, stay connected, and maintain ongoing applications while roaming between IP networks

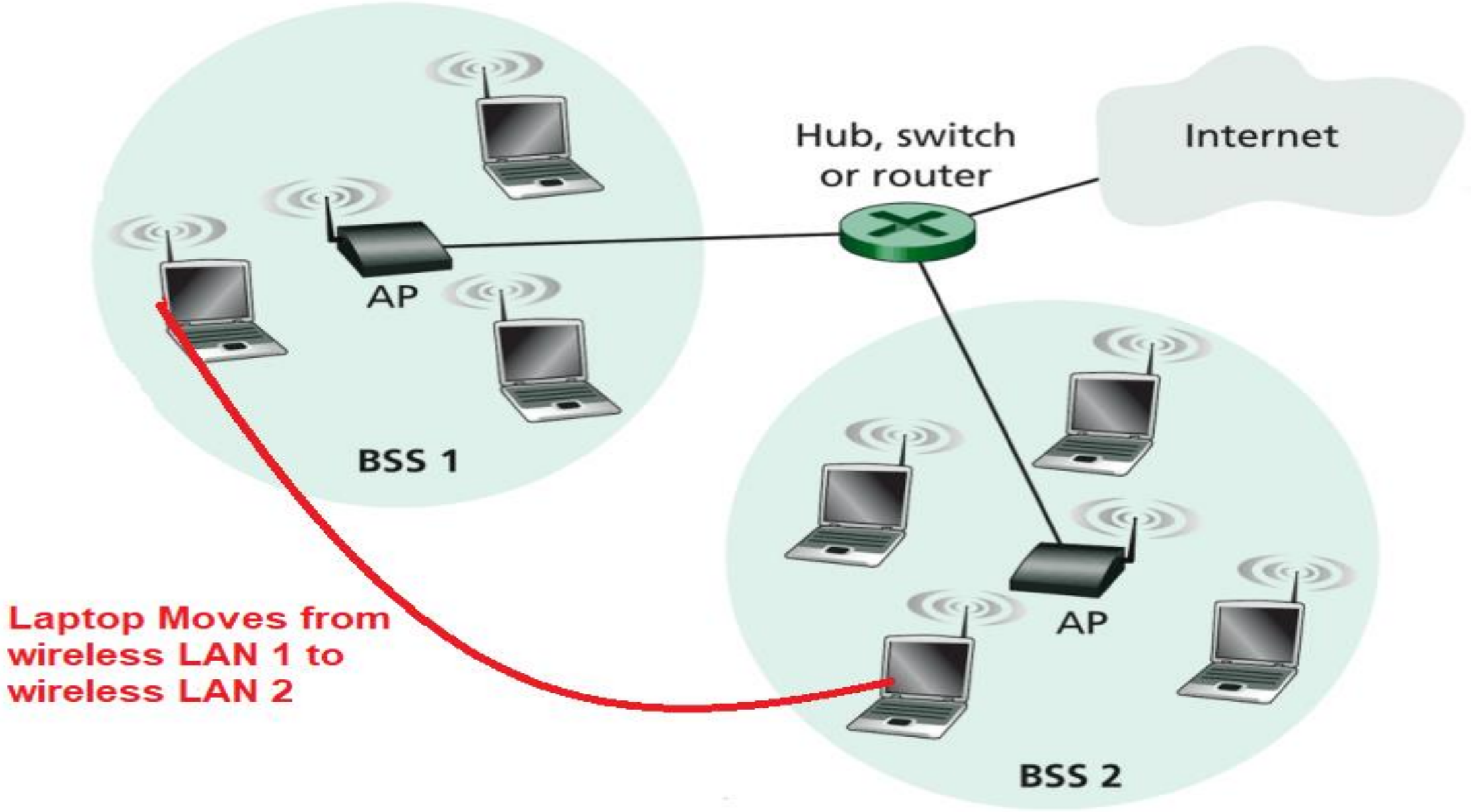
- The basic idea is, as its name suggests – introducing mobility to IP (at the network layer).

Mobility and Mobile Nodes

- Mobility means movement of a mobile node
- Mobility can be defined as the ability of a node to change its point of attachment from one link to another while maintaining all existing communications and using the same IP address at its new link
- A mobile node is one that changes its point of attachment into the network over time. Examples of mobile node such as laptops, phones, tablets etc.
- Normally a mobile node has wireless connections such as infrared, cellular, satellite.
- Wireless technologies make mobility to prevail in network.

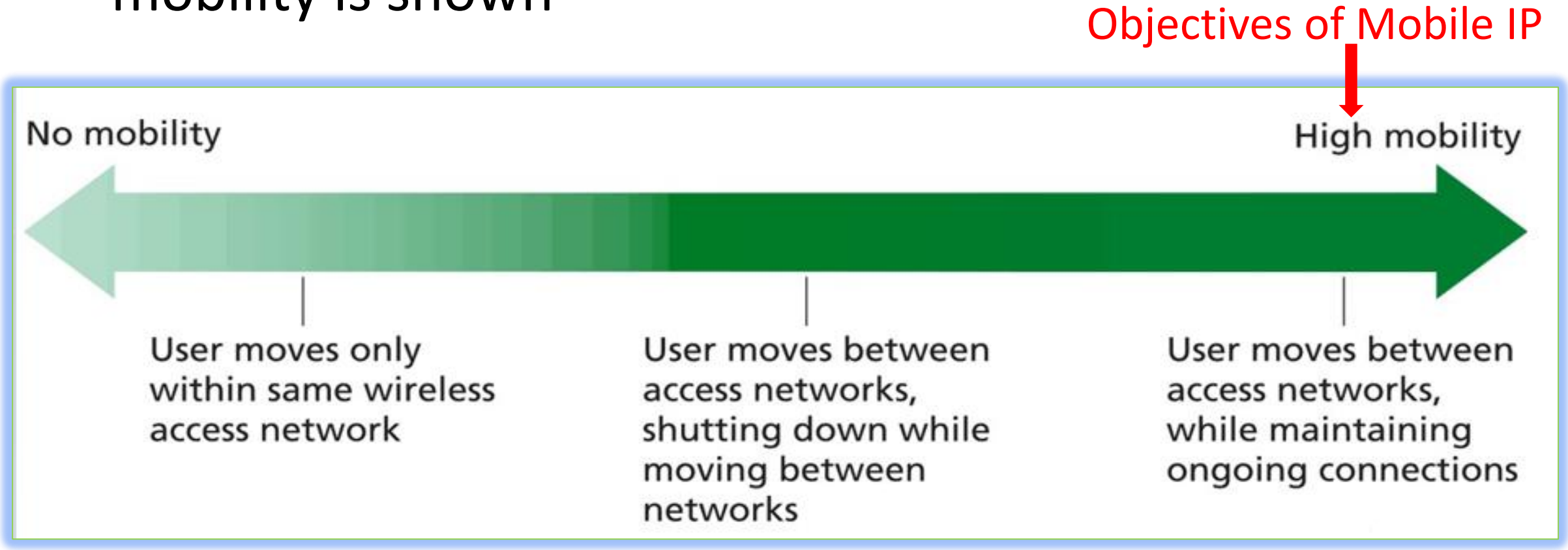
Mobility Examples

- Roaming of mobile phones provided by cellular networks
- A laptop plugged into a new ethernet
- A mobile node moves within a wireless LAN
- A mobile node moves from one wireless LAN to another


Hub, switch
or router
Internet
AP
BSS 1
AP
BSS 2
Laptop Moves from
wireless LAN 1 to
wireless LAN 2

Degrees of Mobility

From network layer's point of view, various degrees of mobility is shown



Why to maintain ongoing connection?

- Many applications require uninterrupted ongoing connections.
- It improves the usability of network because users remain connected and continue to use the network as they move about.
- It is natural of users to expect this when the wireless technology has enabled users to access the network at any time and from anywhere.

How to maintain ongoing connection?

- An internet application should be aware of the IP address and the port number of the remote device it is communicating with
- A connection is identified by
  - ✓ source IP & source port number and
  - ✓ destination IP & destination port number
- Therefore the IP address of a mobile device must remain the same even after it has moved

What is the need for Mobile IP?

- The original IP does not support host mobility
- The IP address of a mobile user is changed manually or by DHCP when connecting to Internet at a different point or through a different network

Motivations of Mobile IP?

- To solve the problem of a mobile node leaving its home network but wants to keep its home IP address.
- The mobility of mobile user is transparent to the applications and other network users

Mobile IP Design Strategy – Transparency

- Applications need to be concerned with the mobility of nodes.
- Non-mobile nodes need not be concerned with the mobility of nodes
- Most routers need not be concerned with the mobility of nodes.

Design Strategy – (cont.)

- A mobile host should be able to use its home IP address anywhere.
- There should be no changes to router tables, backbone or subnet routers.
- The routes taken by packets to mobile hosts should not be excessively long.
- There should be no overhead when the mobile host is “at home”.

Mobile IP Design – Problem Analysis

Various problems that need to be dealt with, in order to support movement at the IP layer.

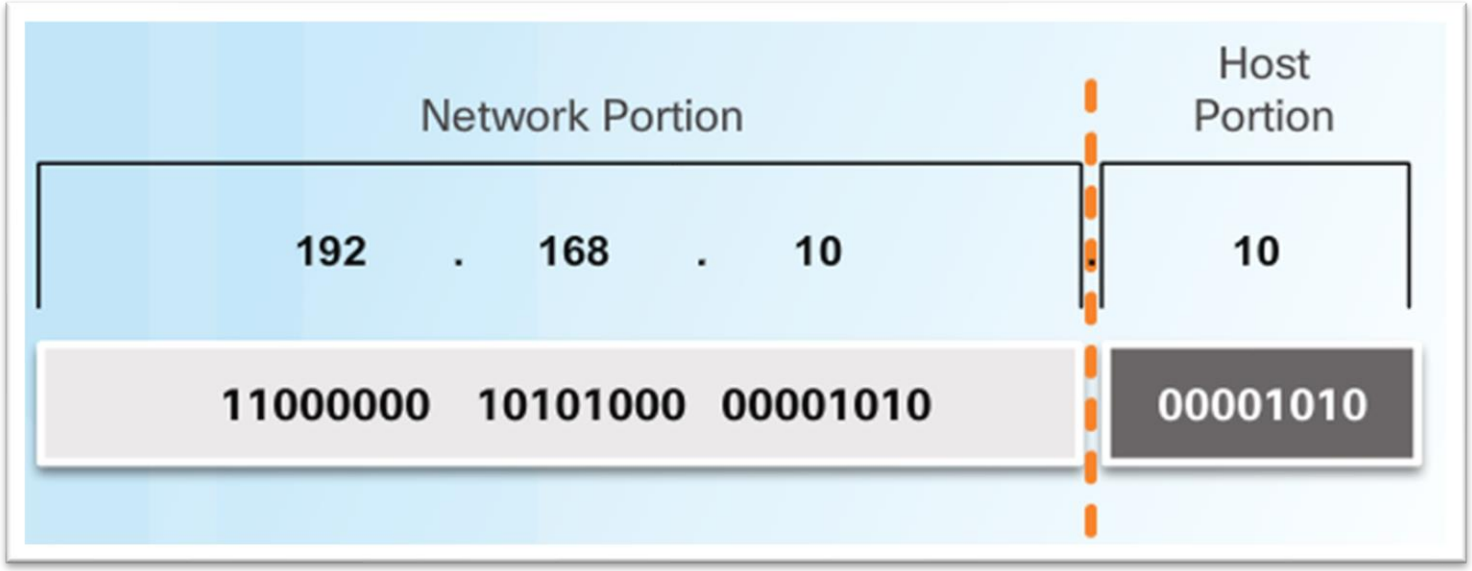
- ✓ Problem 1: Routing to mobile host
- ✓ Problem 2: Location Registry
- ✓ Problem 3: Packet Tunneling

Problem 1: Routing to Mobile Host

- Internet addressing is hierarchical.
  - Network number (subnet number) + host number
- Internet routing is also hierarchical.
  - Routers in the Internet know and care only how to route packets based on the subnet number of the destination address in each packet.
  - Once the packet reaches that subnet, it is delivered to the correct individual host on that subnet.
  - Aggregation is used in routing to reduce the size of the routing tables.

Routing to Mobile Host (cont.)

- IP address is a hierarchical address that is composed of *Network portion* and a *Host portion*



- When determining the network portion versus the host portion, it is necessary to look at the 32-bit stream.

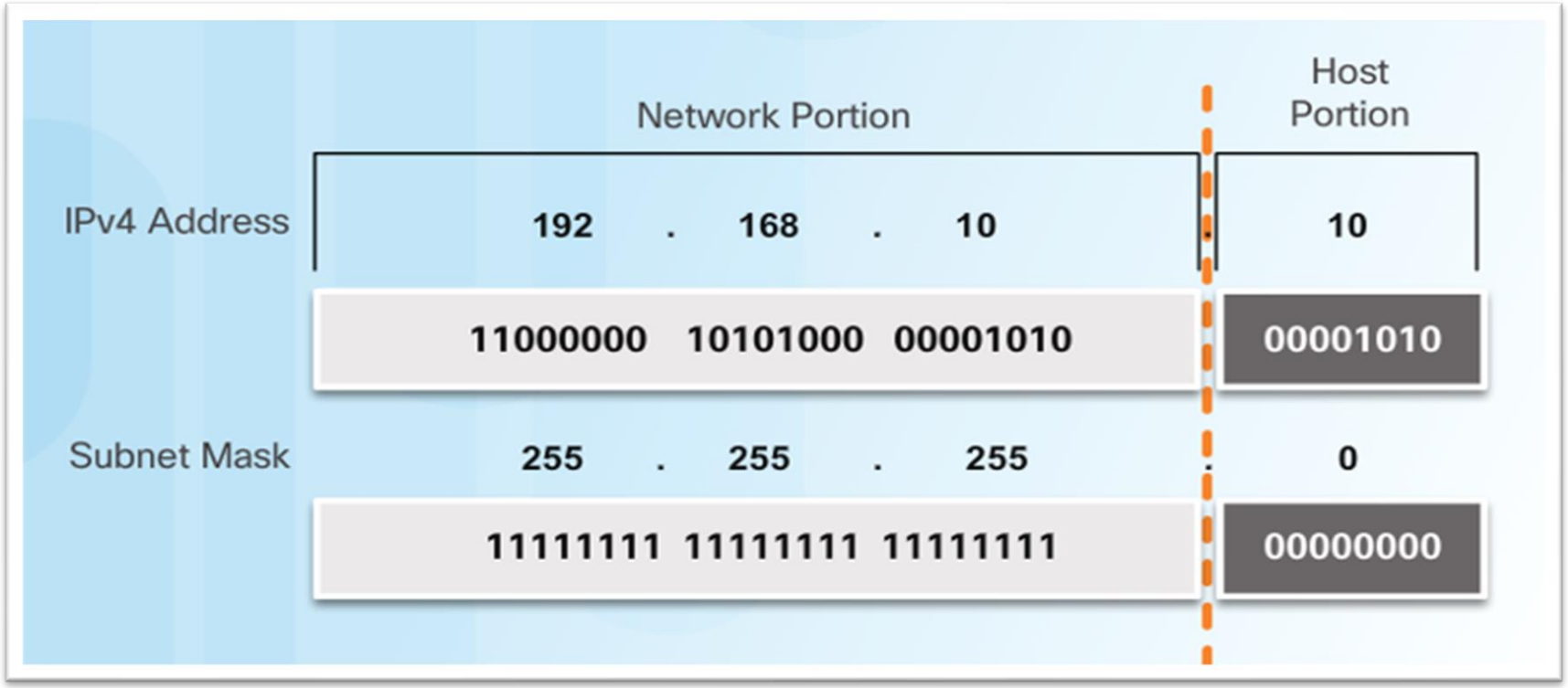
- Within the 32-bit stream, a portion of the bits identify the network, and a portion of the bits identify the host as shown in the figure.

Routing to Mobile Host (cont.)

Subnet Mask

- Subnet mask is 32-bit number
- The subnet mask is used to identify the network/host portion of the IPv4 address
- The 1s in the subnet mask identify the network portion and the 0s identify the host portion

Routing to Mobile Host (cont.)



- The IPv4 address is compared to the subnet mask bit by bit, from left to right.
- A 1 in the subnet mask indicates that the corresponding bit in the IPv4 address is a network bit.

Routing to Mobile Host (cont.)

- The hierarchy in addressing and routing prevents packets from being routed to a mobile host when it moves away from its home network.
  - Why?
    - Packets addressed to a mobile node will be routed by the Internet routers only to the mobile node's home address.
    - Without special handling for mobility management in routing, these packets will be dropped after arriving at mobile node's home network
  - Analogies?
    - If you move to a new house, and you don't tell your current address to the new tenants at your old house, the letters to your old address may be lost.
- Therefore mobile IP protocol is needed to handle packet routing to a mobile host.

Problem 2: Location Registry

- How to receive letters from others after you move to a new house?
  - ✓ Telling friends your current address
    - ➢ This solution is not suitable in the Internet as transparency strategy requires that other corresponding node should not be aware of the mobility of a mobile node.
  - ✓ Asking the new tenants in your old address to forward letters to your current address
    - ➢ This solution is feasible in the Internet since the correspondent hosts don't need to be concerned of the mobility of the mobile node.
    - ➢ It requires an agent to forward packet to a mobile node, and the agent should be aware of the current address of the mobile node.
    - ➢ The agent obtains the current address of the mobile node through a location registry.

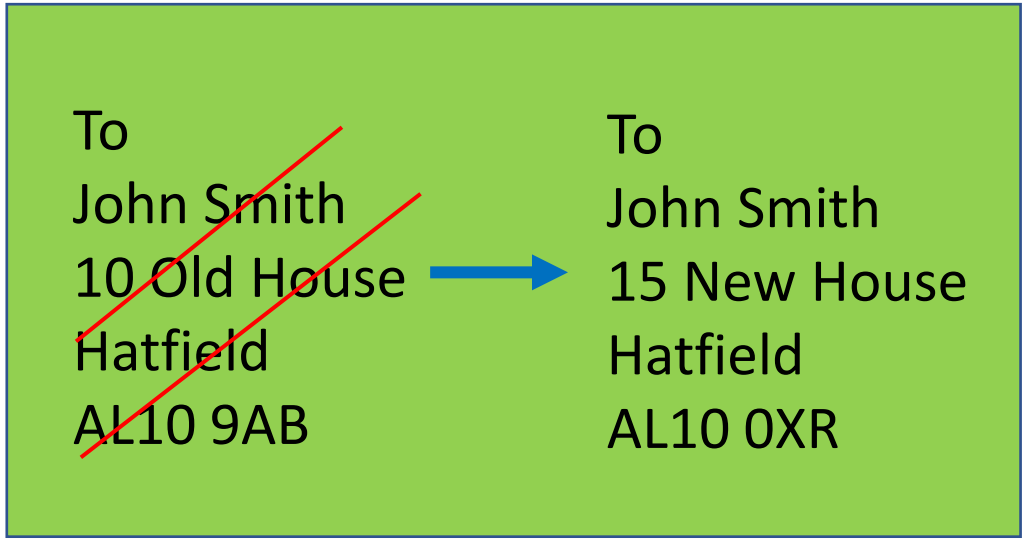
Location Registry (cont.)

- A location registry records a mobile host's current location and is accessed through the mobile node's home network.
  - The agent at the home network will read the current location of a mobile host in the location registry when it forwards packets to the mobile nodes.
- Accessing the location registry through the mobile host's home network avoids any requirement from changes to the basic routing algorithms of the Internet.
- This also allows each local network to manage the location registry for all of its own mobile hosts, improving scalability and easing manageability.

Problem 3: Packet Tunneling

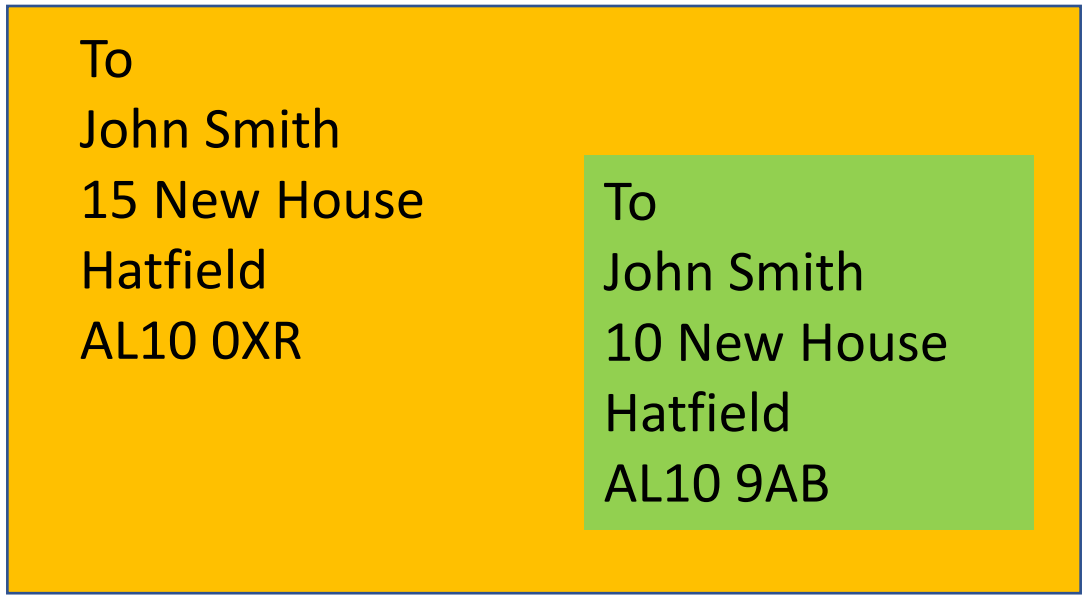
- **How the new tenants in your old address forward a letter to your current address?**

1. They cross the old address on the envelope, write your current address instead, and put the letter into the mailbox.



Packet Tunneling (cont.)

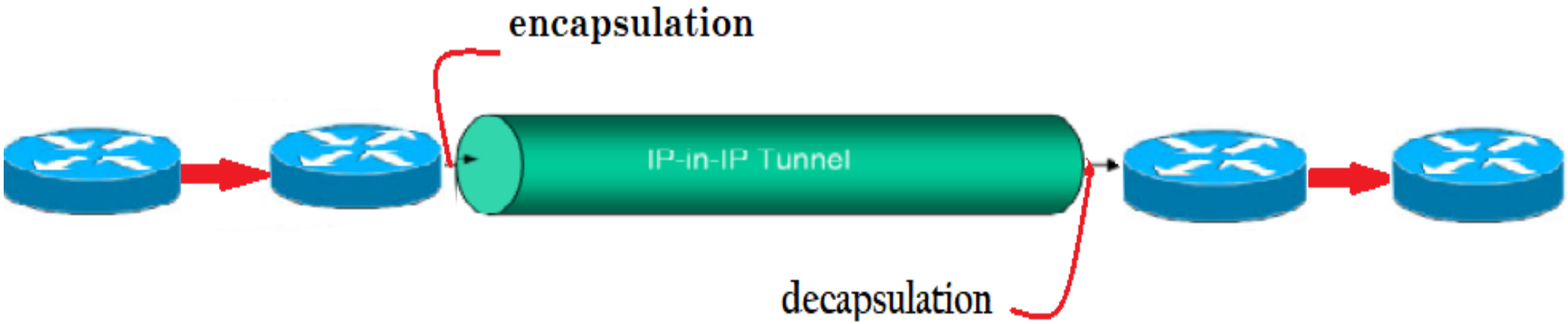
2. They can put the whole letter into a new envelope with your current address on it. Analogies process is called packet/IP tunneling in the Internet.



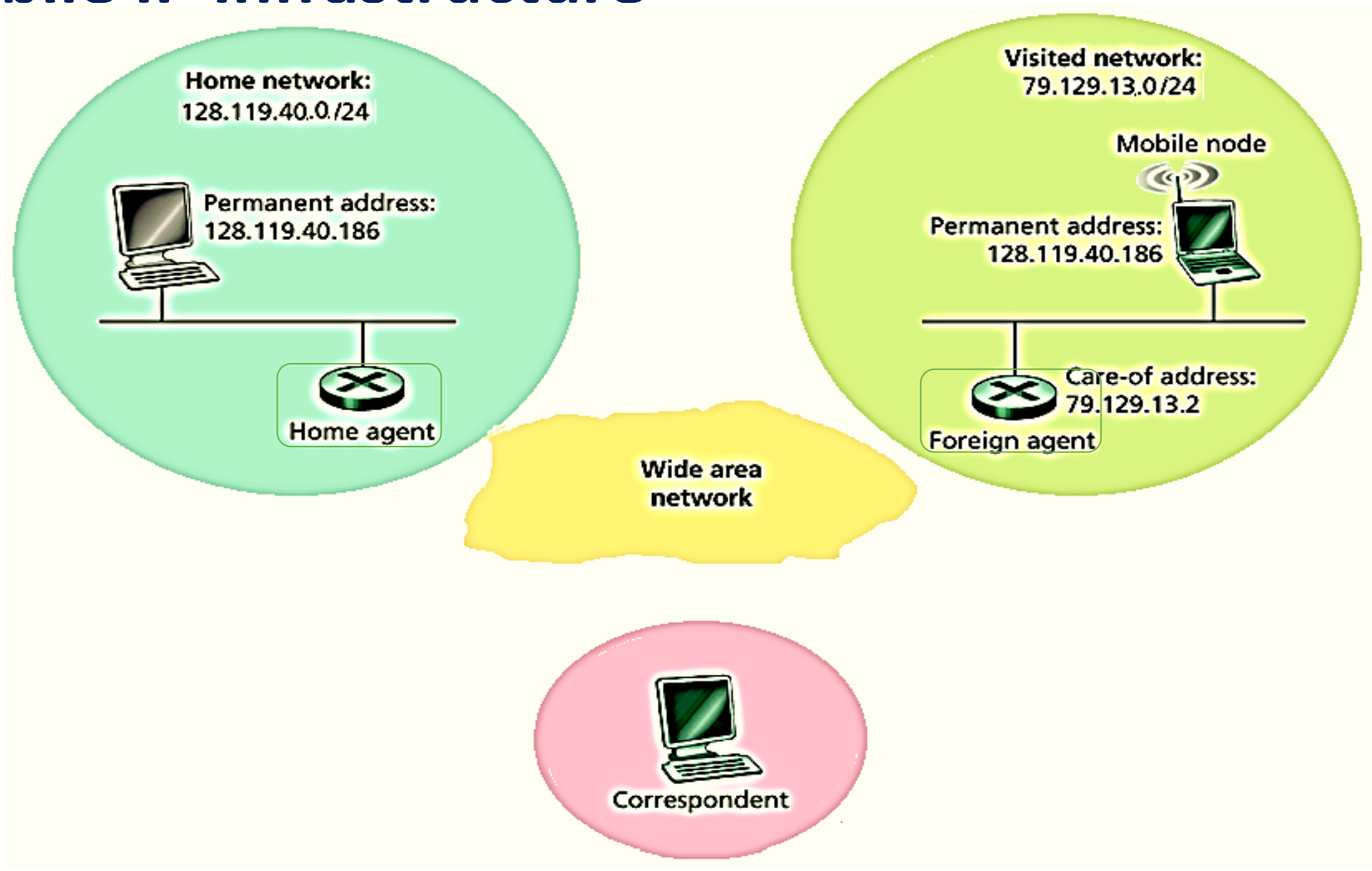
Packet Tunneling (cont.)

- Tunneling is virtual point-to-point link between a pair of nodes.
- At one end of the tunnel, the original IP packet is encapsulated with a new IP header and then sent to the tunnel, leaving the original IP header unchanged.
- At the other end of the tunnel, the new IP header is taken away by de-capsulation, the original IP packet will be sent on the network.
- Only the two endpoints of the tunnel need know that tunneling is taking place.

Packet Tunneling (cont.)



Mobile IP Infrastructure



Mobile IP Infrastructure (cont.)

Main components of Mobile IP

- ✓ Mobile node (MN)
- ✓ Home agent (HA)
- ✓ Foreign Agent (FA)

Mobile IP Infrastructure (cont.)

- Mobile Node: An IP node capable of changing it's point of attachment from one network to another. Example: mobile phone, laptop, etc.
- Home Agent: Basically it's a router that is associated to the home network. It performs the mobility management functions of mobile hosts.
- Foreign Agent: Router associated with foreign network which performs mobility functions of mobile hosts

Mobile IP Infrastructure (cont.)

- Home Network: It is the network where the mobile node belongs to. Mobile node is associated with this network. From the figure, the home network address is **128.119.40.0 /24**

- Home Address: This is the permanent IP address of mobile node. From the figure, the home address is **128.119.40.186 /24.** Even after moving to a foreign network the IP address of mobile node remains same.

Mobile IP Infrastructure (cont.)

- Foreign Network: A visited network where the mobile node moves to. From the figure, the foreign network address is **79.129.13.0/24**

- Care of Address: When the mobile node moves from home network to foreign network, the current location of the mobile node called as care-of-address. It is a temporary address used by the mobile node while visiting the foreign network. From the figure, the care-of-address is **79.129.13.2/24**

Mobile IP Infrastructure (cont.)

- ✓ Home agent maintains a location registry of the mobile nodes of the home network.
- ✓ In the location registry, a mobility binding is kept for each mobile node associating the mobile node's home address with its current care-of-address. This binding is updated along with the mobile node's movement.
- ✓ Home agent forwards packets to mobile nodes.
- ✓ A mobile node registers with a foreign agent of the foreign network to obtain a care-of-address, and the foreign agent acts as a local forwarder for packets arriving for the mobile node.

Mobile IP Infrastructure (cont.)

Components of Mobile IP	Components of the Postal Service
Mobile node	You who moved to a new house
Home agent	Your old local post office
Foreign agent	Your new local post office
Home address	Your old house
Care-of-address	Your new house
Home network	Your old neighbourhood
Foreign network	Your new neighbourhood
Correspondent node	Your friend who sent you a letter