Wireless Mobile & Multimedia Networking
7COM1076
Mobile IP (part 2)

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Outline

- ❑ **Mobile IP Functionalities**
  - ➢ Agent Discovery
  - ➢ Registration
  - ➢ Mobile IP Routing
- ❑ **Agent Discovery**
  - ➢ Agent Advertisement
  - ➢ Agent Solicitation
  - ➢ Agent Advertisement Message
- ❑ **Mobile IP Registration**
  - ➢ Registration with Agents
  - ➢ Registration Request / Reply Message
- ❑ **Mobile IP routing**
  - ➢ Routing from Correspondent Node to Mobile Node
  - ➢ Proxy ARP
  - ➢ Tunneling using IP in IP Encapsulation
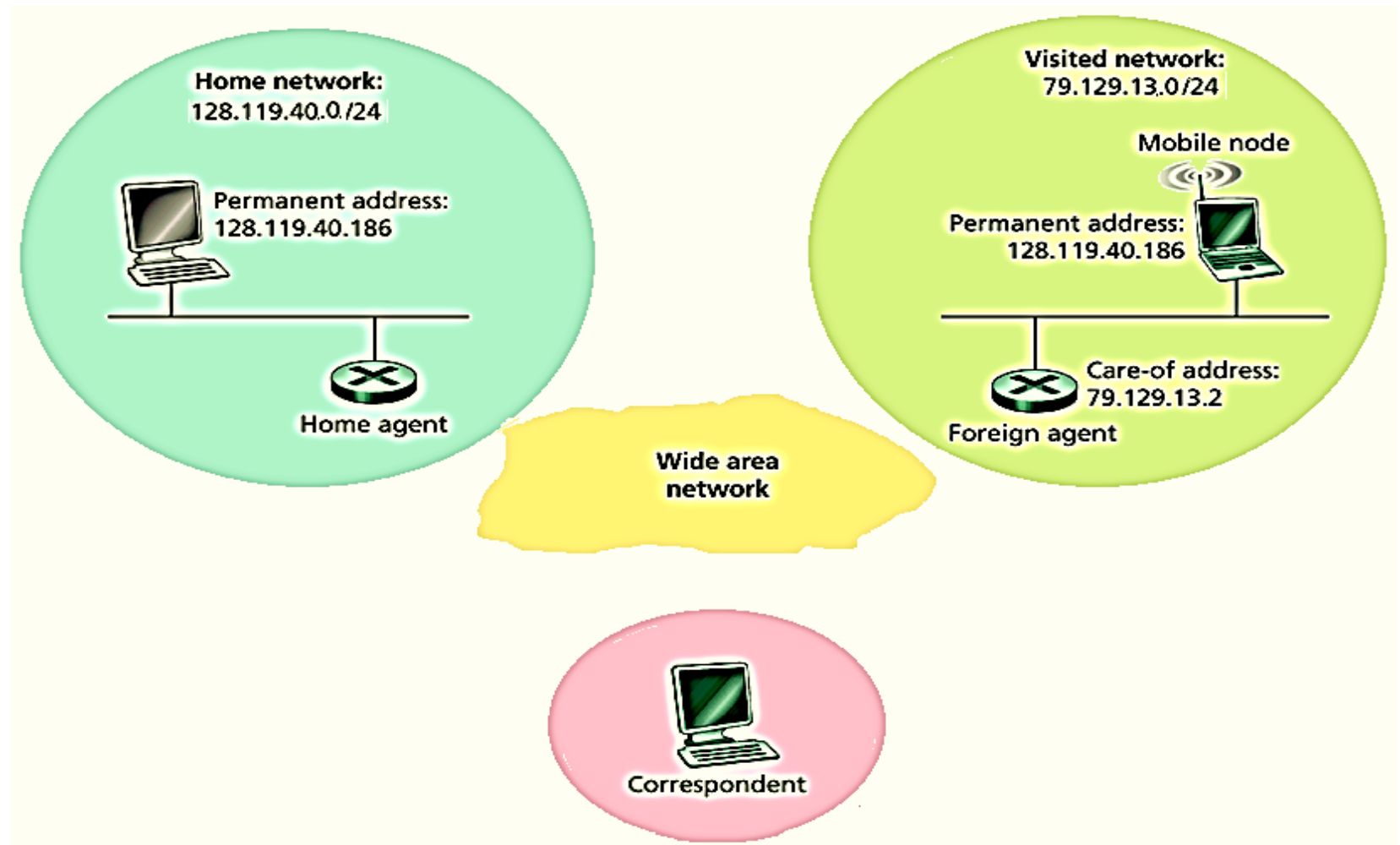 - ➢ Routing from a Mobile Node to a Correspondent Node

Mobile IP Functionalities

The three main functionalities of Mobile IP protocol are:

- ➢ Agent Discovery

- ➢ Registration

- ➢ Tunneling
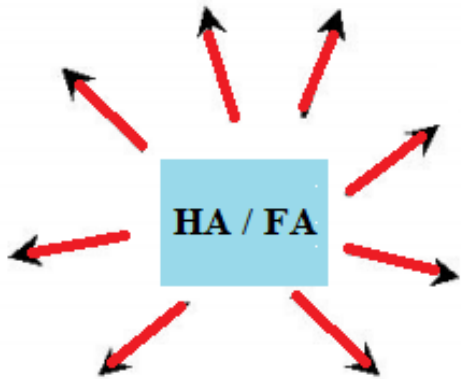
Mobile IP Infrastructure

➢ Home agent and foreign agent are key components of Mobile IP infrastructure.

Agent Discovery

- **How does mobile node detect its home/foreign agent?**

  1. The home agent and foreign agent periodically advertises their presence in their respective networks by multicasting messages called as *Agent Advertisements.*

     - **What is multicasting?**

       It means message is sent from one source to multiple destinations. Here the home agent or foreign agent is the sender, and the group of mobile nodes that this agent is communicating are the multiple receivers.

HA / FA

Agent Discovery (cont.)

2. The Agent Advertisement message, consists of information such as *"This is a home/foreign agent of this network, you could come and register with me."*

3. Mobile node use the Agent Discovery Protocol to examine the advertisement message to determine which network it is in.

Agent Discovery (cont.)

4. Agent discovery protocol runs between mobile nodes, home agents and foreign agents

5. If the MN is in its home network, then it behaves like any other stationary device. It does not use any mobile IP functionality.

6. If the mobile node detects that it has left its home network and entered a foreign network, it will try to register and obtain the care-of address (COA)

Agent Solicitation

Agent Solicitation (cont.)

1. A mobile node may multicast Agent Solicitation Message on to its current network if it does to receive number of consecutive expected agent advertisement messages.

2. This perhaps is because its HA or FA has failed.

3. Maybe because mobile node needs the information of the agents immediately.

4. The Agent Solicitation message, consists of information such as: "Where is a HA / FA agent of this network?"

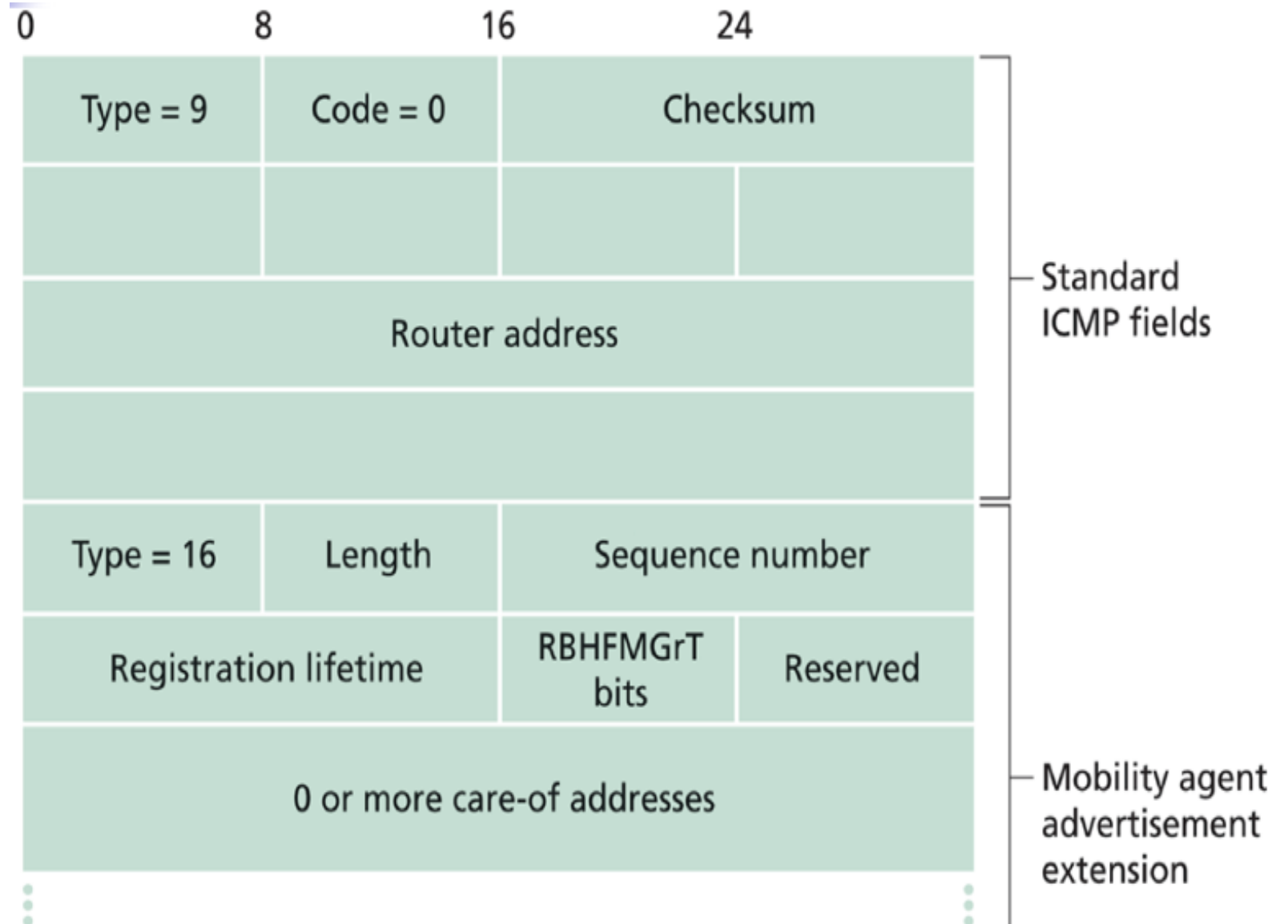5. The reply to the Agent Solicitation message should be an Agent Advertisement message from HA or FA

Agent Advertisement Packet

❖ Important to note that Mobile IP does not use any new packet type, rather it reuses the router advertisement packet of ICMP and append agent advertisement in it

Agent Advertisement Packet

ICMP messages are used with some mobility extensions.

In the figure, the upper part represents the standard ICMP fields and the lower part is the mobility agent advertisement extension.

0	8	16	24	
Type = 9	Code = 0	Checksum		Standard ICMP fields
Router address				
Type = 16	Length	Sequence number		Mobility agent advertisement extension
Registration lifetime		RBHFMGrT bits	Reserved	
0 or more care-of addresses				

Agent Advertisement Packet (cont.)

Description of the important fields in advertisement packet are as follows:

1. *Sequence number*: Indicates the sequence number of this message. To check the consistency of message.

2. *Registration lifetime*: Indicates the registration lifetime if a mobile node registers with this agent. How long the agent will accept request from the MN.

3. *Code* is an 8-bit flag, which shows the information in the datagram

4. *Care-of address (COA) fields*. A list of one or more care-of addresses provided by the foreign agent

Agent Advertisement Packet (cont.)

Code bits:

R	B	H	F	M	G	r	T

1. R: Registration required bit (R): Indicates that a mobile user in this network must register with a foreign agent

2. B: Indicates agent is busy and does not accept registration at this moment

3. H: Home agent bit : Indicates that the agent is a home agent.

4. F: Foreign agent bit : Indicates that the agent is a foreign agent

5. M: Agent uses minimal encapsulation

6. G: Agent uses generic routing encapsulation

7. r: sent as zero, ignored at reception. Unused.

8. T: MN requesting the reverse tunneling for packets originated by MN

After the agent discovery process, MN will use the information from the advertisement message which includes COA to register with the agents.

Mobile IP Registration

➢ What is the main objective of MN to register with the agents?
  ✓ To inform HA of its current location for correct forwarding of packets

1) **When establishing service with a new FA**
  ▪ MN must register with that FA
  ▪ MN also needs to register with its HA to inform it of it's new COA.

2) **When MN is temporarily assigned a local IP address as COA via DHCP**
  ▪ MN needs to registers with its HA
  ▪ But no need to register with a FA because now MN acts as its own FA in this case

3) **When MN is at home or has returned home**
  ▪ MN needs to register/re-register with its HA

Mobile IP Registration

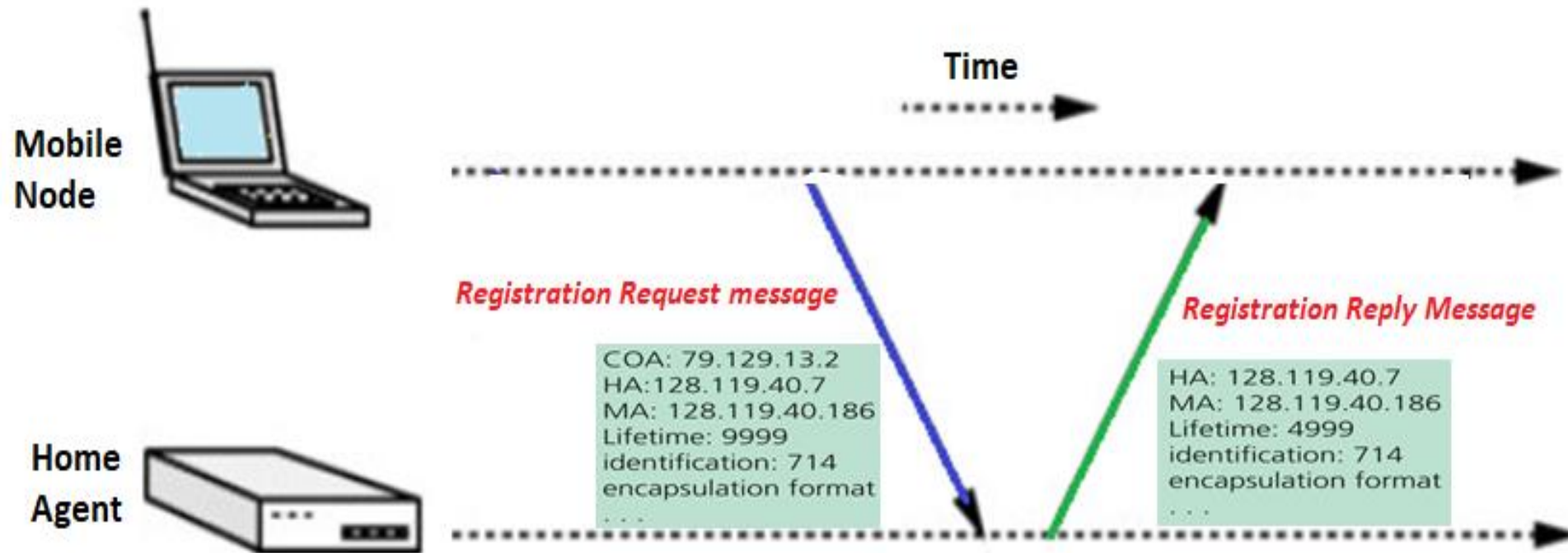There are 2 types of registration messages:

1. Registration Request

2. Registration reply

Registration with a Home Agent

1. Mobile node sends a *registration request message* to its home agent

2. The home agent receives the registration request message and check for authenticity and correctness. If everything is fine, then the home agent binds the home address of the mobile node with the care-of address. The home agent then return a *registration reply message* to the mobile node.

3. Mobile node now knows that it is connected with the home agent
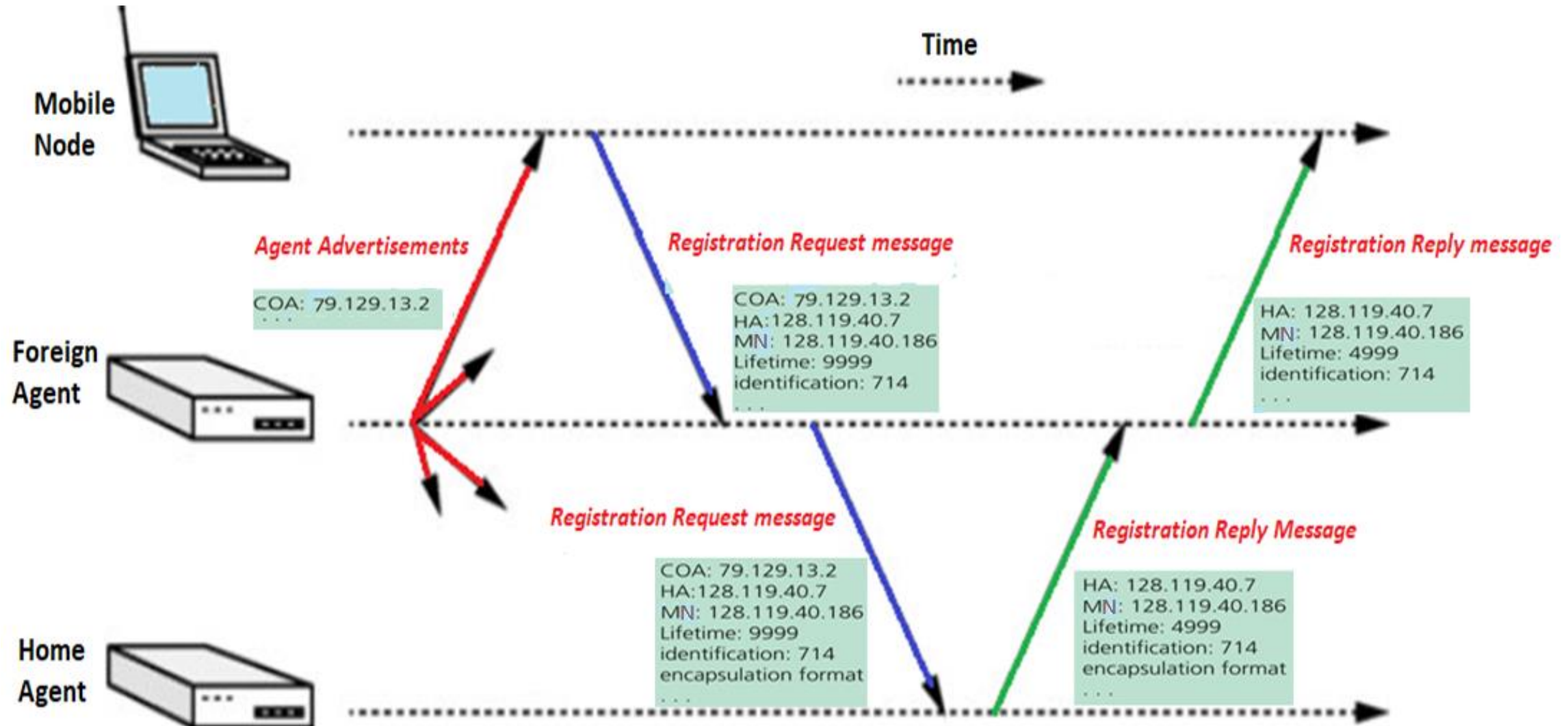
Registration with a Home Agent

Registration with a Foreign Agent

1. Mobile node sends a *registration request message* to the foreign agent

2. The message includes:
   i. The home address of mobile node,
   ii. Address of its home agent and
   iii. The COA address it received from foreign agent during agent discovery process

3. The foreign agent receives the registration request message and records the mobile node's home address. The foreign agent now knows that it should be looking for datagrams containing an encapsulated datagram whose destination address matches this home address.

4. The foreign forwards this registration request message to the home agent.
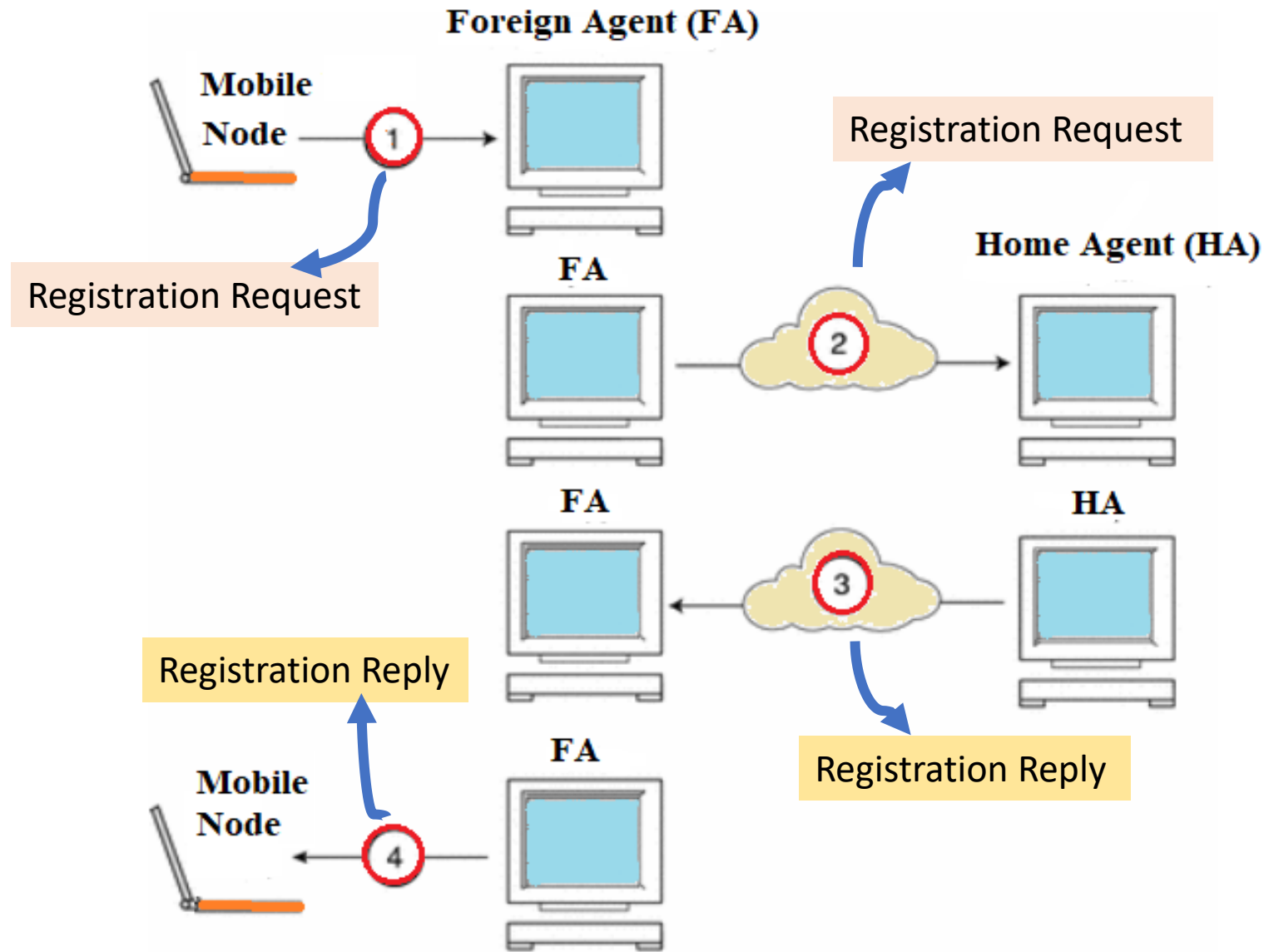
Registration with a Foreign Agent

5. The home agent receives the registration request message and check for authenticity and correctness. If everything is fine, then the home agent binds the home address of the mobile node with the care-of address. The home agent then return a *registration reply message* to the mobile node.

6. The foreign agent forwards the registration reply message to the mobile node.

Registration (cont.)

Time

Mobile Node

Foreign Agent

Home Agent

Agent Advertisements

COA: 79.129.13.2
. . .

Registration Request message

COA: 79.129.13.2
HA:128.119.40.7
MN: 128.119.40.186
Lifetime: 9999
identification: 714
. . .

Registration Reply message

HA: 128.119.40.7
MN: 128.119.40.186
Lifetime: 4999
identification: 714
. . .

Registration Request message

COA: 79.129.13.2
HA:128.119.40.7
MN: 128.119.40.186
Lifetime: 9999
identification: 714
encapsulation format
. . .

Registration Reply Message

HA: 128.119.40.7
MN: 128.119.40.186
Lifetime: 4999
identification: 714
encapsulation format
. . .

Mobile IP Design Strategy – Transparency

Registration Request Message

- ➢ Registration request message is carried within a UDP datagram.

- ➢ Important fields are:
  - A care-of address advertised by the foreign agent and chosen by the mobile node.
  - The home address of the mobile node.
  - The address of the mobile node's home agent.
  - The requested lifetime of the registration.
    - Indicates the number of seconds that the registration is to be valid.
    - If the registration is not renewed at the home agent within the specified lifetime, the registration becomes invalid.
  - A 64-bit registration identification.
    - Acts like a sequence number.
    - Serves to match a received registration reply with a registration request.
  - Encapsulation format requested

Registration Reply Message

➢ Registration request message is carried within a UDP datagram.

➢ Important fields are:

- The home address of the mobile node.
- Home agent address of the mobile node.
- The actual lifetime of the registration.
- The 64-bit registration identification.
- Encapsulation format

Mobile IP Routing

➤ **From a correspondent to a mobile node**

- Correspondent sends packet out as normal to the home network.
- Home agent collects packets destined to the mobile node by using proxy ARP.
- Home agent forwards the packets to foreign agent by using tunnelling.
- Foreign agent delivers the packets to the mobile node directly

➤ **From a mobile node to a correspondent**

Treated as normal packets from a source to a destination on the Internet.

Routing to Mobile Node
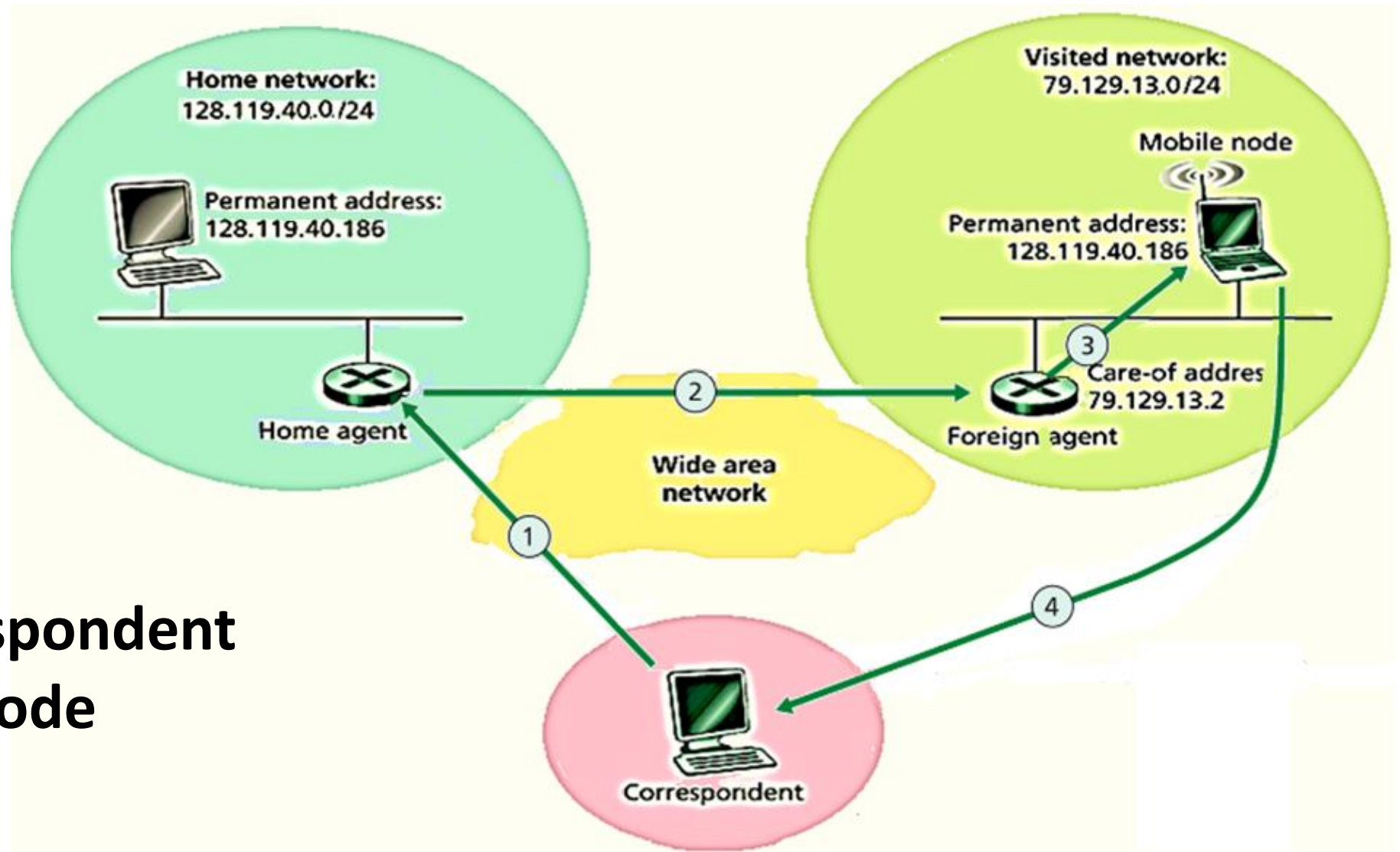
From correspondent to mobile node

Routing to Mobile Node (cont.)

Arp is the process of mapping a dynamic IP address with the permanent MAC address in the network.

Proxy ARP

- Used by a home agent to collect packet destined to a mobile node by "cheating" in the ARP protocol.
- As a result the home address of the mobile node is bound with the MAC address of the home agent so as the packets addressed to the mobile host are sent to the home agent.
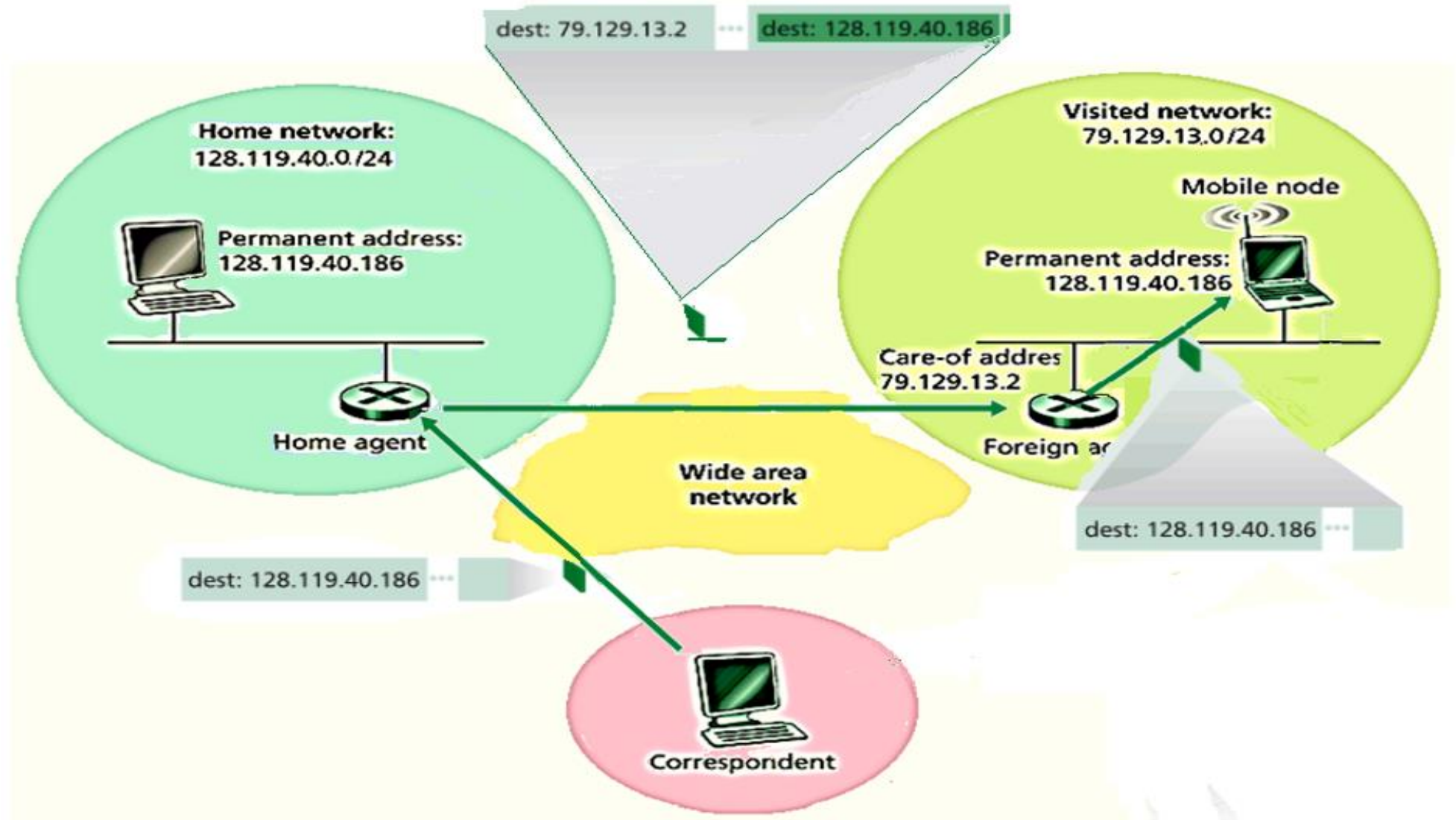
ARP TABLE

Home address of mobile host | MAC address of mobile host

Home address of mobile host | MAC address of home agent

Routing to Mobile Host (cont.)

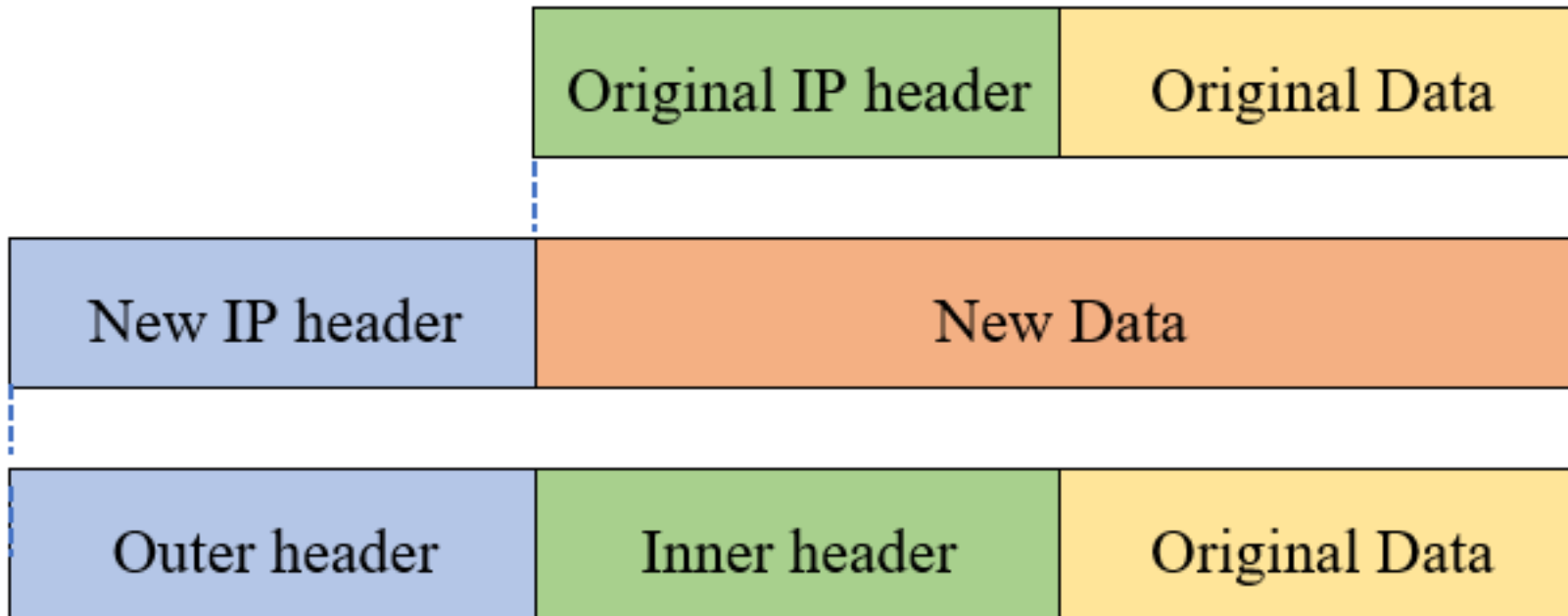**Tunneling**

Mobile IP Tunneling

❑ **Using "IP in IP" encapsulation**

- ▪ A new IP header is wrapped around the existing packet, E.g., 20 bytes are added to each packet.
- ▪ The source address in the new IP header is set to the address of the node tunneling the packet (the home agent);
- ▪ The destination address in the new IP header is set to the mobile host's care-of-address.
- ▪ This method can be used for tunneling any packet, but with high overhead.
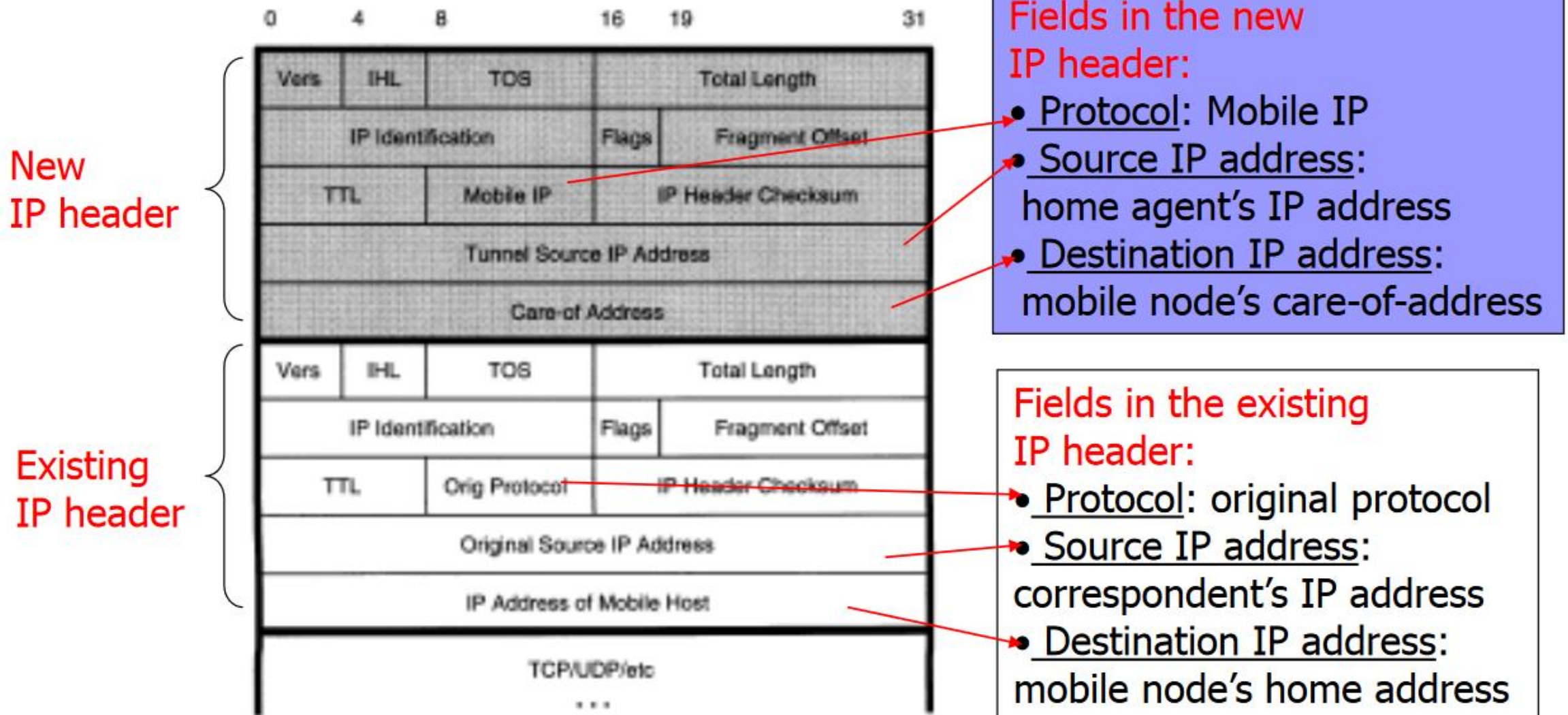
❑ **Using the minimal tunneling protocol**

- ▪ This method adds only 8 or 12 bytes to each packet.
- ▪ Only the modified fields of the original IP header are copied into a new forwarding header.
- ▪ This method adds less overhead

Mobile IP Tunneling using "IP in IP" Encapsulation

Mobile IP Tunneling using "IP in IP" Encapsulation

Thank you | Any Questions?

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