

# **7. MOBILE IP**

**CS-1699 Wireless Networks**

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# MOBILE IP USES

- It is not a standard of a wireless technology
  - But wireless technology may extend mobility capacity of its user
- Enable computers to maintain Internet connectivity while moving from one Internet attachment point to another
- Mobile – user's point of attachment changes dynamically and all connections are automatically maintained despite the change
  - From communication protocol perspective, it occurs in network layer → In TCP/IP, it is internet layer
  - Routing of packet destined to mobile unit becomes challenging
- Nomadic - user's Internet connection is terminated each time the user moves and a new connection is initiated when the user dials back in
  - New, temporary IP address is assigned

# OPERATION OF MOBILE IP

- Mobile node is assigned to a particular network – home network
- IP address on home network is static – home address
- Mobile node can move to another network – foreign network
- Mobile node registers with network node on foreign network – foreign agent
- Mobile node gives care-of address to agent on home network – home agent

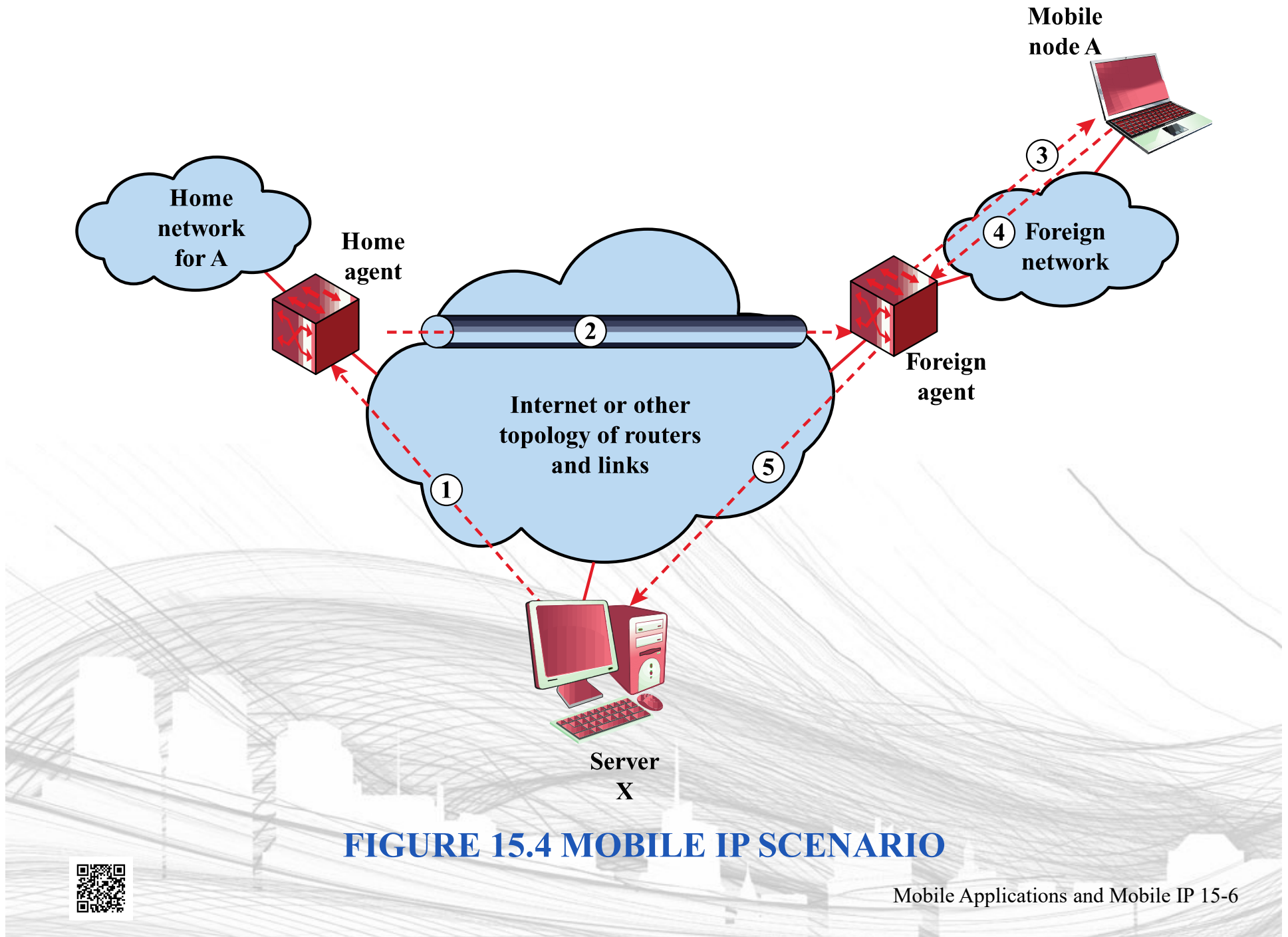
# MOBILE IP TERMINOLOGY

Based on RFC 5944 for IPv4

Terms	Remarks
Mobile node	A host or router that changes its point of attachment from one network or subnetwork to another. A mobile node may change its location without changing its IP address. It may continue to communicate with other Internet nodes at any location using its (constant) IP address, assuming link layer connectivity to a point of attachment is available
Home address	An IP address that is assigned for an extended period of time to a mobile node. It remains unchanged regardless of where the node is attached to the internet
Home agent	A router on a mobile node's home network, which tunnels datagram for delivery to the mobile node when it is away from home and maintains current location information for the mobile node
Home network	A network, possibly virtual, having a network prefix matching that of a mobile node's home address. Note that standard IP routing mechanism will deliver datagrams destined to a mobile node's home address to the mobile node's home network

# MOBILE IP TERMINOLOGY

Terms	Remarks
Foreign Agent	A router on a mobile node's visited network which provides routing services to the mobile node while registered. The foreign agent detunnels and deliver datagrams to the mobile node that were tunneled by the mobile node's home agent. For datagram sent by a mobile node, the foreign agent may serve as a default router for registered mobile nodes
Foreign network	Any network other than the mobile node's home network
Care of address	The termination point of a tunnel toward a mobile node, for datagrams forwarded to the mobile node while it is away from home.
Correspondent node	A peer with which a mobile node is communicating. A correspondent node may either mobile or stationary
Link	A facility or medium over which nodes can communicate at the link layer. A link underlies the network layer
Node	A host or a router
Tunnel	The path followed by a datagram while it is encapsulated. While it is encapsulated, a datagram is routed to knowledgeable decapsulating agent, which decapsulates the datagram and then correctly deliver to its ultimate destination

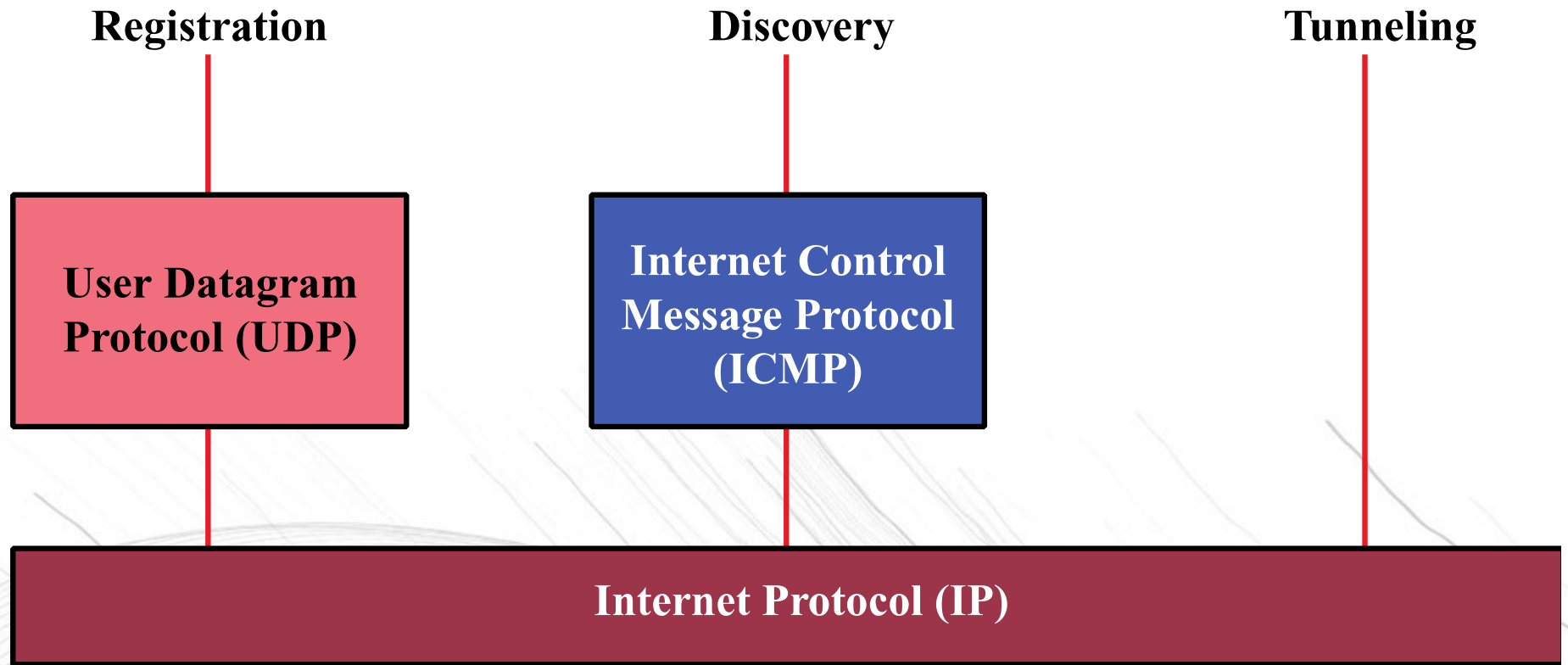


**FIGURE 15.4 MOBILE IP SCENARIO**



# CAPABILITIES OF MOBILE IP

- Discovery – mobile node uses discovery procedure to identify prospective home and foreign agents
- Registration – mobile node uses an authenticated registration procedure to inform home agent of its care-of address
- Tunneling – used to forward IP datagrams from a home address to a care-of address



**FIGURE 15.5 PROTOCOL SUPPORT FOR MOBILE IP**



# DISCOVERY

- Mobile node is responsible for ongoing discovery process
  - Must determine if it is attached to its home network or a foreign network
- Transition from home network to foreign network can occur at any time without notification to the network layer
- Mobile node listens for agent advertisement messages
  - Compares network portion of the router's IP address with the network portion of home address

# AGENT SOLICITATION

- Foreign agents are expected to issue agent advertisement messages periodically
- If a mobile node needs agent information immediately, it can issue ICMP router solicitation message
  - Any agent receiving this message will then issue an agent advertisement

# MOVE DETECTION

- Mobile node may move from one network to another due to some handoff mechanism without IP level being aware
  - Agent discovery process is intended to enable the agent to detect such a move
- Algorithms to detect move:
  - Use of lifetime field – mobile node uses lifetime field as a timer for agent advertisements
  - Use of network prefix – mobile node checks if any newly received agent advertisement messages are on the same network as the node's current care-of address

# CO-LOCATED ADDRESSES

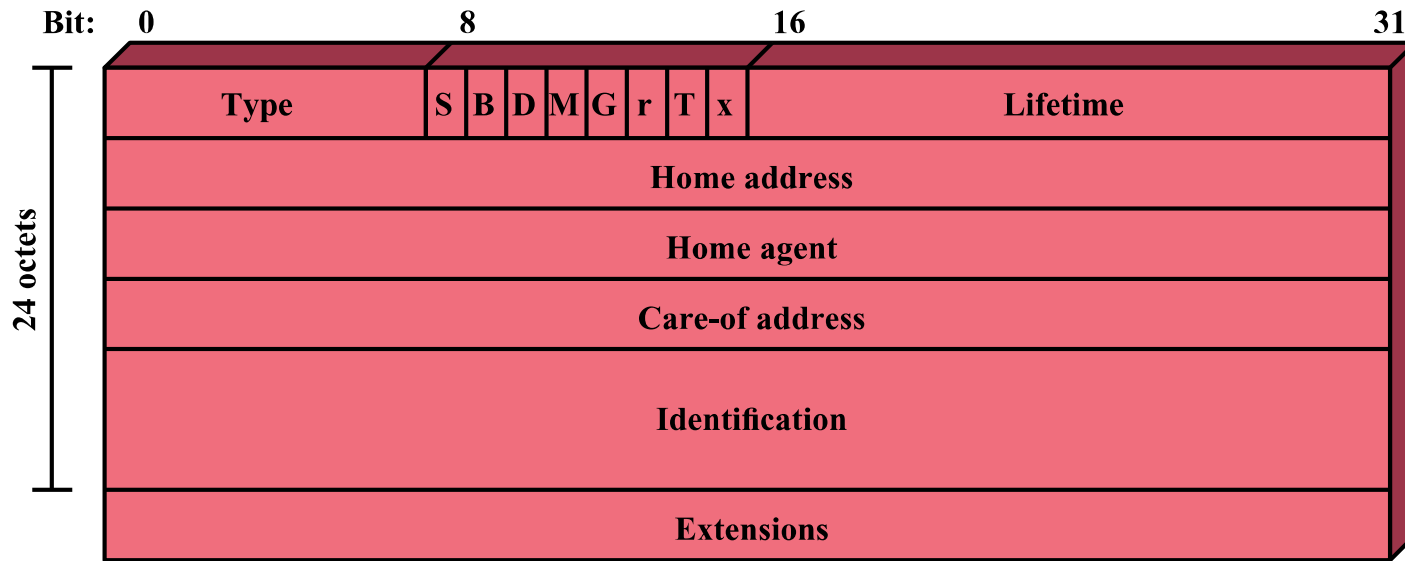
- If mobile node moves to a network that has no foreign agents, or all foreign agents are busy, it can act as its own foreign agent
- Mobile agent uses co-located care-of address
  - IP address obtained by mobile node associated with mobile node's current network interface
- Means to acquire co-located address:
  - Temporary IP address through an Internet service, such as DHCP
  - May be owned by the mobile node as a long-term address for use while visiting a given foreign network

# REGISTRATION PROCESS

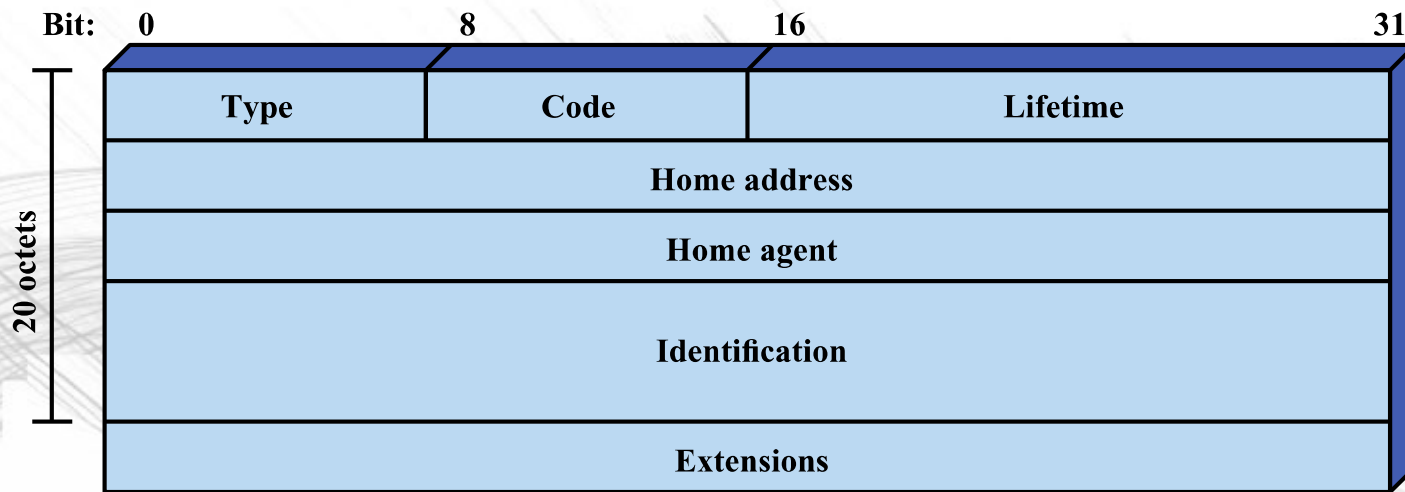
- Mobile node sends registration request to foreign agent requesting forwarding service
- Foreign agent relays request to home agent
- Home agent accepts or denies request and sends registration reply to foreign agent
- Foreign agent relays reply to mobile node

# REGISTRATION OPERATION MESSAGES

- Registration request message
  - Fields = type, S, B, D, M, V, G, lifetime, home address, home agent, care-of-address, identification, extensions
- Registration reply message
  - Fields = type, code, lifetime, home address, home agent, identification, extensions



(a) Registration request message



(b) Registration reply message

## FIGURE 15.6 MOBILE IP REGISTRATION MESSAGES

# REGISTRATION REQUEST FIELDS

- Type
  - 1, indicate request
- S : Simultaneous bindings
  - The mobile node is requesting that the home agent retain its prior mobility bindings.
- B
  - Broadcast datagram. Indicates that the mobile node would like to receive copies of broadcast datagrams
- D
  - Decapsulation by mobile node
- M
  - Indicates that the home agent should use minimal encapsulation
- G
  - The home agent should use GRE
- r, x :
  - Reserved



# REGISTRATION REQUEST FIELDS

- T
  - Reverse tunneling requested
- Home Address
  - The home IP address of the mobile node
- Home Agent
  - The IP address of the mobile's home agent
- Care of Address
  - The IP address of at this end of tunnel
- Identification
  - A 64 bit number generated by the mobile node, used for matching registration request to registration replies
- Extension
  - So far , it is for authentication extension

# REGISTRATION REPLY FIELDS

- Type
  - 3, indicates that this is the reply
- Code
  - Indicates result of the registration request
- Lifetime
  - The number of seconds before the registration is considered expired
- Home Address
  - The home IP address of the mobile node
- Home Agent
  - The IP address of the mobile node's home agent
- Identification
  - A 64 bit number generated by the mobile node, used for matching registration request to registration replies
- Extension

# REGISTRATION PROCEDURE SECURITY

- Mobile IP designed to resist attacks
  - Node pretending to be a foreign agent sends registration request to a home agent to divert mobile node traffic to itself
  - Agent replays old registration messages to cut mobile node from network
- For message authentication, registration request and reply contain authentication extension
  - Fields = type, length, security parameter index (SPI), authenticator

# TYPES OF AUTHENTICATION EXTENSIONS

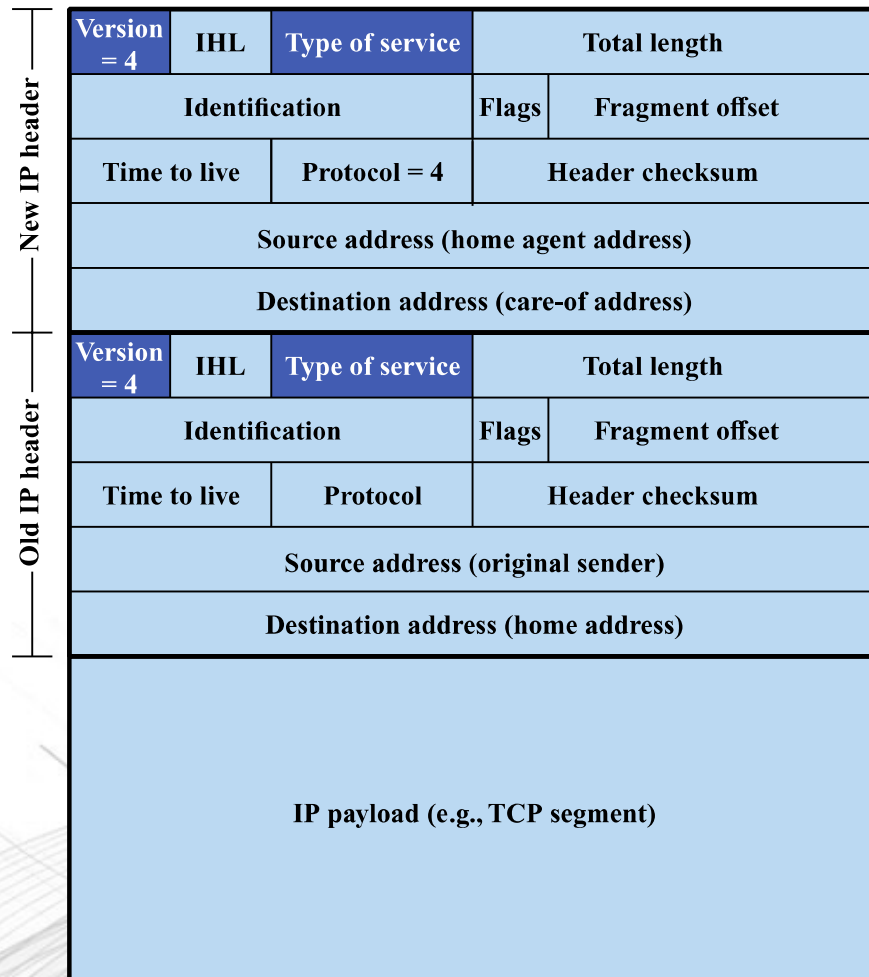
- Mobile-home – provides for authentication of registration messages between mobile node and home agent; must be present
- Mobile-foreign – may be present when a security association exists between mobile node and foreign agent
- Foreign-home – may be present when a security association exists between foreign agent and home agent

# TUNNELING

- Home agent intercepts IP datagrams sent to mobile node's home address
  - Home agent informs other nodes on home network that datagrams to mobile node should be delivered to home agent
- Datagrams forwarded to care-of address via tunneling
  - Datagram encapsulated in outer IP datagram

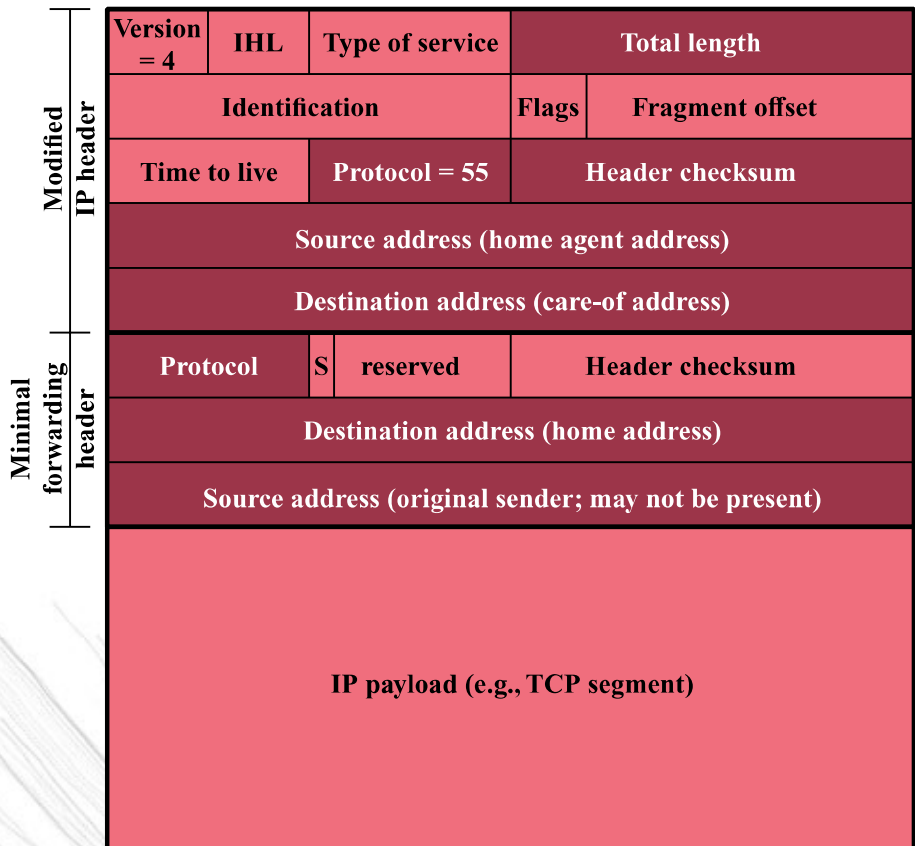
# MOBILE IP ENCAPSULATION OPTIONS

- IP-within-IP – entire IP datagram becomes payload in new IP datagram
  - Original, inner IP header unchanged except TTL decremented by 1
  - Outer header is a full IP header
- Minimal encapsulation – new header is inserted between original IP header and original IP payload
  - Original IP header modified to form new outer IP header
- Generic routing encapsulation (GRE) – developed prior to development of Mobile IP



Shaded fields are copied from the inner IP header to the outer IP header.

(a) IP-within-IP encapsulation



Shaded fields in the inner IP header are copied from the original IP header. Shaded fields in the outer IP header are modified from the original IP header.

(b) Minimal encapsulation

## FIGURE 15.8 MOBILE IP ENCAPSULATION

