ter Analysis

- One of the most important chapters in the entire syllabus, both in terms of theory and viva.
- Questions are spread out over almost the entire chapter and not just concentrated on a few sections.
- Diagrams are especially important.

9.1 Mobile IP

- Mobile IP is an emerging set of protocols created by the *Internet Engineering Task Force (IETF)*.
- Basically, it is a modification to *IP (Internet Protocol)* that allows nodes to continue to receive packets independently of their connection point to the Internet.
- Mobile IP is a network layer solution for homogenous and heterogeneous mobility on the global Internet which is scalable, robust, and secure and allows nodes to maintain all ongoing communications while moving.
- It allows transparent routing of IP datagrams on the Internet.

9.1.1 Mobile IP Goals

- The IP has limitations due to its proper characteristics.
  - To send a packet on the Internet, a computer must have an IP address.
  - This IP address is associated with the computer's physical location.
  - TCP/IP protocol routes packets to their destination according to the IP address.
  - Hence, once a computer changes its IP address, it can no longer receive any packets.
- In order to support mobility, the standard IP must be modified.
- The goals of mobile IP are,
  - Give mobile users full Internet experience, not just a limited menu of specialized Web services, or only e-mail.
  - Be reasonably fast with at least 100 kbps throughput per user.
  - Work indoors and outdoors to both stationary and mobile users.
  - Use power efficiently, because most devices will run on batteries.
  - It should be simple to implement mobile node software.
  - The size and frequency of required routing updates should be as small as possible.
  - It should scale up to support millions of active devices, or more, within a single metropolitan region.

9.1.2 Requirements

- The requirements of mobile IP are,

(1) Transparency

- Mobility should remain invisible for higher layer and applications.
- Mobile end-systems can keep their fixed IP address.
- Continuation of communication after interruption of link should be possible.
- Point of connection to the fixed network can be changed.

(2) Compatibility

- Mobile IP should remain compatible with existing protocols and applications.
- It should provide same support to the layer 2 protocols as IP.
- No changes to current end-systems and routers should be required.
- It should ensure that all the users can still access all other servers and systems.

(3) Security

- All messages related to the management of mobile IP should be authenticated.
- However, to ensure complete security, other security mechanisms must be implemented in the higher layers.

(4) Efficiency

- Use of network
- Also, it

- Thus, the gen while maintain existing applic

9.1.3 Entities and

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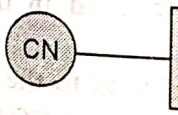

- **Mobile Node**
  - It is an end Internet usi whose softw
  - MN can ke computer in
- **Correspondent**
  - It is a node
  - A CN can be
- **Home Network**
  - It is the area
  - Mobile IP network.
- **Foreign Networ**
  - It is the area

(4) Efficiency and Scalability

- Use of mobile IP should not degrade the efficiency of the existing network.
- Also, it should be scalable to a large number of users all over the world.

➤ Thus, the general goal of mobile IP should be to support end-system mobility while maintaining scalability, efficiency and compatibility in all aspects with the existing applications and other Internet protocols.

9.1.3 Entities and Terminology (V.IMP)

Q.1. Explain the following entities in brief : (i) Foreign agent (iii) Home agent (ii) Care of address (iv) Mobile node. **[Dec. 06, May 08] (4 M)**

Q.2. List the entities of mobile IP and describe data transfer from a mobile node to a fixed node and vice versa. **[May 12] (5 M)**

➤ Some of the entities and terminologies related to mobile IP are, (refer *figure 9.1*).

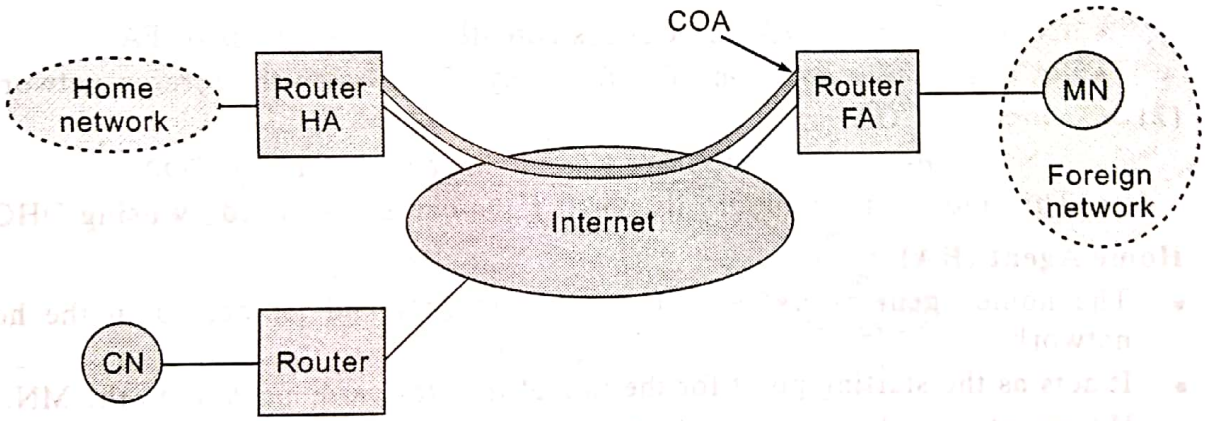

Fig. 9.1 : Important Players in Mobile IP

➤ **Mobile Node (MN)**

- It is an end-system or a router that can change its point of attachment to the Internet using mobile IP. It can be a device such as a cell phone, PDA, laptop whose software enables network roaming capabilities.
- MN can keep its IP address and can continuously communicate with any computer in the Internet as long as it remains connected.

➤ **Correspondent Node (CN)**

- It is a node with which the MN communicates.
- A CN can be a fixed or a mobile node.

➤ **Home Network**

- It is the area in a network to which the MN originally belongs.
- Mobile IP support is not required as long as a node is within its home network.

➤ **Foreign Network**

- It is the area under a foreign agent where MN has gone while roaming.

- It is the subnet which MN visits and is outside the home network.

➤ **Foreign Agent (FA)**

- FA provides many services to a visiting MN.
- It is usually implemented on a router of the foreign network.
- It may function as the point of attachment for MN when it roams to a foreign network, delivering packets from Home Agent to MN.
- FA can also provide security services to MN.

➤ **Care Of Address (COA)**

- It is the temporary address of MN that defines the current location of MN from IP point of view.
- In a foreign network all the packets destined for MN are delivered at COA.
- IP Packets are forwarded to MN via a tunnel. COA marks the end-point of the tunnel.
- There are two different possibilities for the location of COA,

(1) Foreign Agent COA

- ♦ COA is located at FA i.e., COA is actually the IP address of FA.
- ♦ FA can act as a common COA for many MNs within the foreign network.

(2) Co-located COA

- ♦ MN acquires a new temporary IP address that acts as the COA.
- ♦ This address is topologically correct and can be acquired by using DHCP.

➤ **Home Agent (HA)**

- The home agent offers several services to MN and is located in the home network.
- It acts as the starting point for the tunnel that forwards packets to the MN.
- HA maintains a location registry that maps a MN with its current COA.
- HA is usually implemented on the router responsible for the home network.

9.1.4 IP Packet Delivery (V.V.IMP)

Q.1. Explain packet flow if two mobile nodes communicate. **[May 05, Dec. 07] (6 M)**

Note: *Write case 3 and case 4 only.*

Q.2. Explain IP packet delivery to/from mobile host. **[May 10] (10 M)**

Q.3. Explain with respect to mobile IP : IP packet delivery. **[May 11] (3.5 M)**

➤ Mobile IP support is not required as long as MN is in its home network. In its home network MN can directly receive and send packets from/to CN.

➤ If MN is in a foreign network then the following cases arise,

➤ **Case 1 : A fixed CN sends a packet to MN** (refer *figure 9.2*)

- CN sends the packet as usual to the original fixed IP address of MN. Mobility of MN is transparent to CN.

- By default, the packet is routed via standard routing mechanisms of the Internet to the router responsible for the Home Network of MN. HA is implemented on this router.
- HA intercepts the received packet and realizes that the required MN is not currently in the home network.
- HA then looks up the current COA of MN, encapsulates the received packet and forwards it to COA via a so-called *tunnel*. (We assume that COA for MN is the IP address of FA).
- FA marks the end point of the tunnel. It receives the packet, decapsulates it and forwards it to MN.
- Thus, even for MN, mobility is transparent. It receives the packet with the same sender and receiver address as it would have done in the home network.

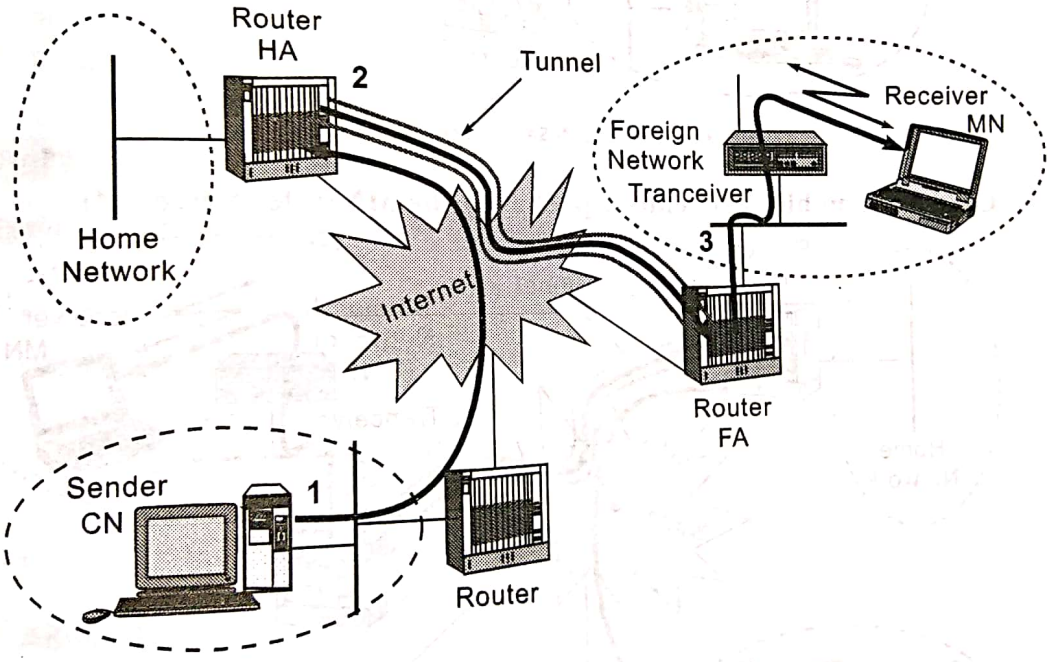

Fig. 9.2 : Case 1 : Fixed CN Sends Packet to MN

▸ **Case 2 : MN sends a packet to a fixed CN** (refer *figure 9.3*)

- MN sends the packet with its original IP address as the sender's address and CN's address as the destination address.
- The FA responsible for the foreign network acts as the default router and forwards the packet to the default router responsible for CN.
- The router responsible for CN then forwards the packet to CN.

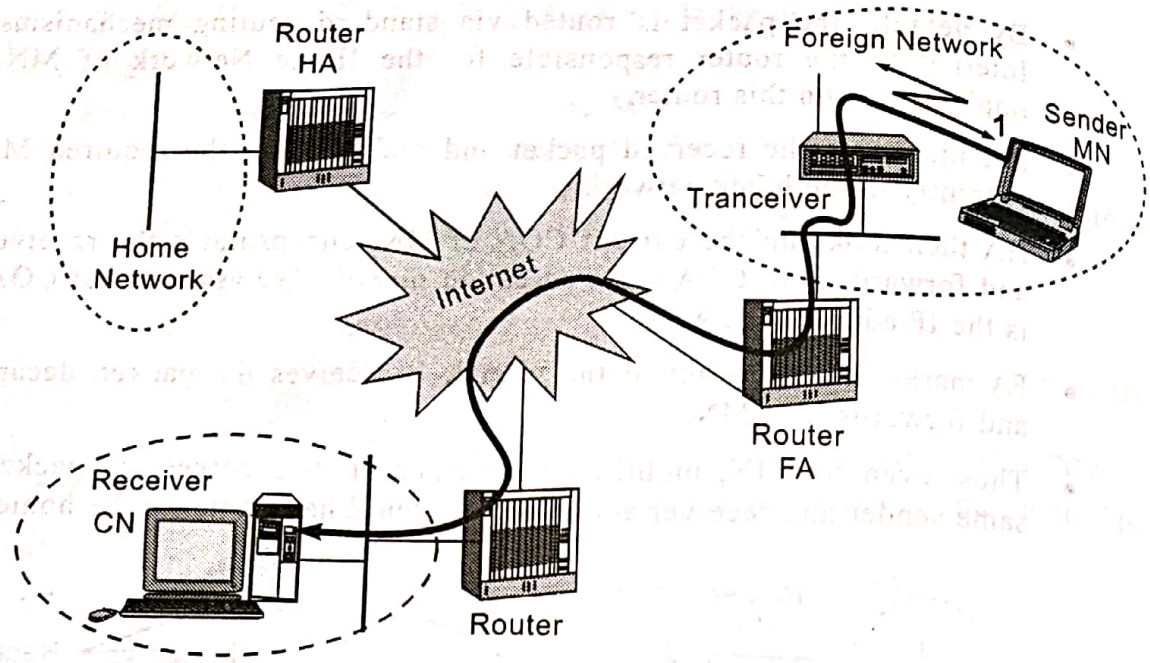

Fig. 9.3 : Case 2 : MN Sends Packet to Fixed CN

- **Case 3 : A mobile CN sends a packet to the MN** (refer *figure 9.4*)

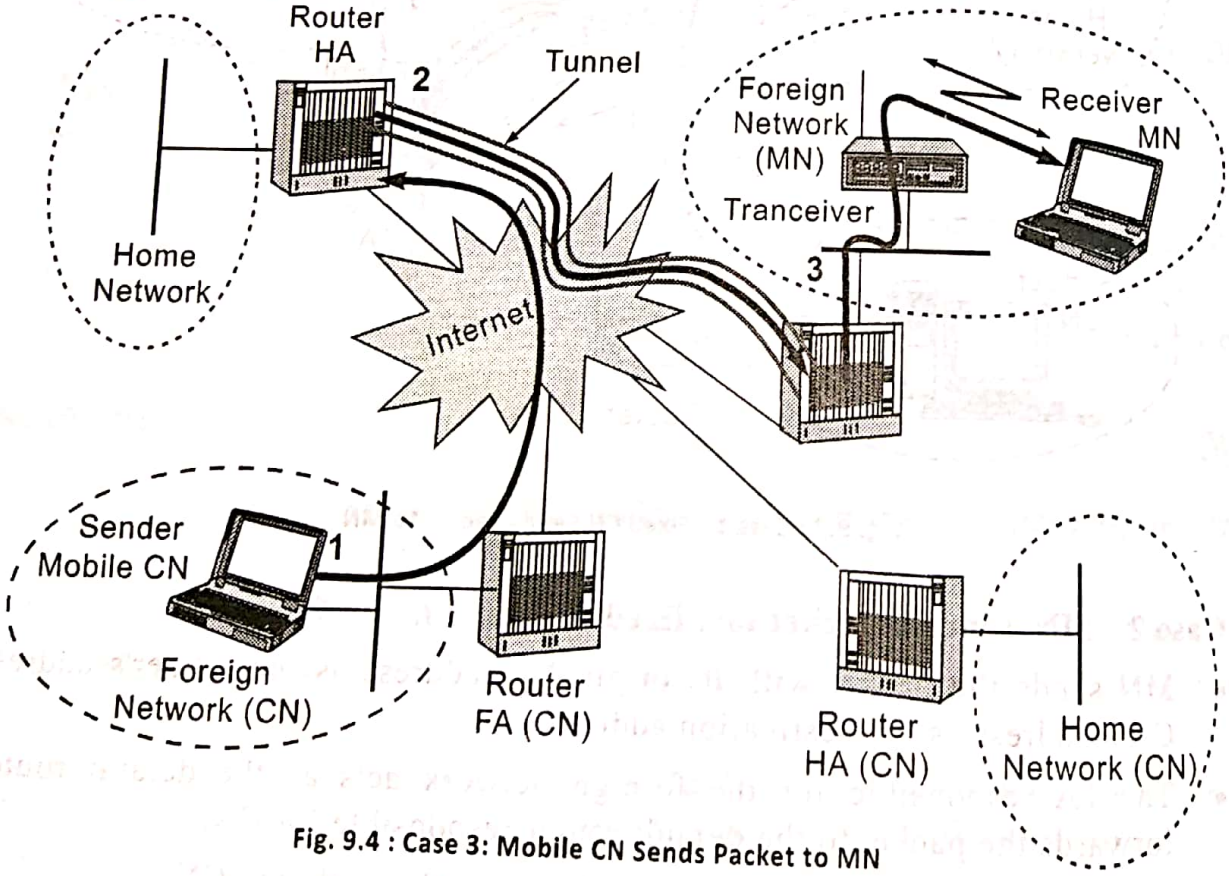

Fig. 9.4 : Case 3: Mobile CN Sends Packet to MN

- CN sends the packet with its original IP address as the sender address and MN's address as the receiver address.
- The FA responsible for CN routes the packet to the router responsible for the home network of MN.

- As in case 1, HA intercepts the received packet and realizes that the required MN is not currently in the home network.
- It then looks up the current COA of MN, encapsulates the received packet and forwards it to COA via a so-called 'tunnel'. (We assume that COA for MN is the IP address of FA).
- The FA marks the end point of the tunnel. It receives the packet, decapsulates it and forwards it to MN.

➤ **Case 4 : MN sends packet to a mobile CN**

- The entire process is same as in case 3. The only difference is that the roles of MN and CN are interchanged.
- Thus, MN first sends the packet to the router responsible for the home network of CN.
- The HA for CN then encapsulates the received packet and forwards it to COA of CN.
- FA decapsulates the packet and forwards the packet to CN.

9.1.5 Agent Discovery

Q.1. Explain with respect to Mobile IP : Agent discovery **[May 11] (3.5 M)**

➤ Agent discovery allows MN to,

- Determine whether it is at home or not.
- Detect whether it has moved.
- Obtain a COA when away from home.

➤ Agent discovery consists of 2 messages, agent advertisement and agent solicitation which are discussed in the following sections,

9.1.5.1 Advertisement

➤ The functions performed by an agent advertisement are as follows,

- Allows the detection of HAs and FAs.
- Lists one (or more available) COA.
- Informs MN about special features provided by FA, e.g. a list of alternative encapsulation techniques supported.
- Permits MNs to determine the network number and congestion status of their link to the Internet.
- Lets MN know, whether it is in its home network or in a foreign network by identifying whether the agent is a HA, a FA, or both.

➤ The agent advertisement packet along with the extension for mobility is as shown in *figure 9.5*.