A Review on Mobile Internet Protocol (Mobile IP)

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Abstract— Mobile IP is a new internet protocol as compared to the already existing networking protocols used for embracing the connectivity and communication. Mobile computing devices have taken over from the yester years and the hosts (users) demanding connectivity is not stationary as well. There was no such protocol before Mobile IP which would deal with the issues like these. Mobile IP serves the need of the population to connect to the internet and have a uniform connection irrespective of lactation. This paper deals with the background, operation mechanisms, issues along with some of their solutions, advantages of Mobile IP which over weights the disadvantages and finally the conclusion pertaining to the Mobile IP.

Keywords: Approaches in Mobility, Mobile IP, Mobility Vocabulary, Mobile IP Inefficiencies

I. INTRODUCTION

With the rapid rise in the mobile and personal computers (PC's) such as laptops, notebooks, etc the point of attachment to the Internet or network is not static. Current versions of Internet Protocols work on the fact that connection point between the network and the host is fixed. Datagrams are sent on the basis of network address which is contained in the IP address. The location/network address may vary from 8bit to 24bit depending upon its class in case of classful addressing. This network address is not the personal address of the host which it can carry from one point to another. This is only valid when a user (host) is adhered with the network. Using this association routers deliver the packets to the network with which the host is connected. But the problem now is what when if users (hosts) are not stationary?

So, when the hosts move from one network to another the Internet Protocol needs to be modified in such a way that it may serve the hosts with the network connection using the same TCP/IP suite irrespective of location. Some of the proposed solutions to this cause are;

A. Changing the Address:

In this solution the prominence was that mobile hosts will change its address as soon as it enters the new network by using Dynamic Host Configuration Protocol (DHCP). But this approach had many drawbacks; First drawback was that every time host moves from one network to another it needed to be rebooted. The second drawback was that the Domain Name System (DNS) tables needed to be revised so that other hosts in the network also get to know about it. The third drawback was that the configuration files needed to be changed every time.

B. Two Addresses:

This approach was more feasible than the earlier one as this approach employed two addresses instead of one. The permanent address of the host is called the home address and the temporary address in the visited or foreign network is known as the Care-of-address. This gave rise to the Mobile Internet Protocol (Mobile IP) which uses two addresses for the mobile host.

Mobile IP is an Internet Engineering Task Force (IETF) standard communication protocol that embellishes the existing IP to induce mobility. Mobile IP is one of the most widely enhanced and researched protocol. Mobile IP allows hosts to move from one point to another without changing their IP address and allows the point of attachment. A host can disconnect its device from one point and can reconnect from another point at will.

II. MOBILITY VOCABULARY

The entities present in Mobile IP are described and demonstrated as under;

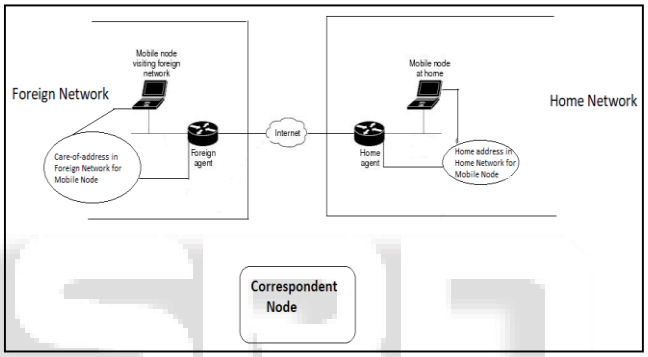

Fig. 1: Entities in Mobile IP

- Home Network (HN): It is the permanent home of the Mobile Node.
- Mobile Node (MN): This refers to the host or router which moves from one network to another i.e., from Home Network to the Foreign Network and changes its point of attachment with the network.
- Home/Permanent Address (PA): This is the permanent address of the mobile present in the home network. It is also called as permanent address. This can be used to reach the Mobile Node.
- Home Agent (HA): This agent performs the mobility operations on behalf of Mobile Node when that is remote. It is the responsibility of the Home Agent to forward the data packets destined to the Mobile Node present in the Foreign Network.
- Correspondent Node (CN): This is the node which wants to communicate with the Mobile Node. Correspondent Node can be residing in any location.
- Foreign/Visited Network (FN): This is the network in which the Mobile Node currently resides after moving from the home network.
- Foreign Agent (FA): This agent performs mobility operations on behalf of Mobile Node in the Foreign Network. It is the responsibility of the Foreign Agent to receive and forward the data packets towards the Mobile Node. It also stores information regarding all the Mobile Nodes visiting its network. One of the main operations

performed by the Foreign Agent is the advertisement of Care-of-address (COA) which is used by Mobile IP.

– Care-of-address (COA): This is the address used by the Mobile Node for communication when it is present in the Foreign/Visited Network. This address is advertised by the Foreign Agent.

III. Approaches in Mobility

Mobility can be handled using following two approaches;

A. *Let Routing Handle It:*

In this approach routers advertise the permanent home address of the Mobile Nodes in vicinity through a usual routing table exchange. Through this the routing tables indicate the location of the Mobile Nodes. There are no changes to the end systems in this approach. But this approach cannot be scalable to the millions of the users. Routing tables need to be feasible to the vast number of hosts which is not the case.

B. *Let End Systems Handle It:*

This approach includes two types of routing namely;

1) *Indirect Routing:*

In this type of routing, communication from Correspondent Node to the Mobile Node goes through the Home Agent and then forwarded to the remote Mobile Node. The data sent by the Correspondent Node has to go through the Home Agent which then forwards the data to the Foreign Agent in the Foreign Network. The Foreign Agent receives and delivers the data to the Mobile Node. The Mobile Node replies directly to the Correspondent Node. Since, the data packets from the Correspondent Node reaches indirectly via Home Agent, this approach is thus known as Indirect Routing.

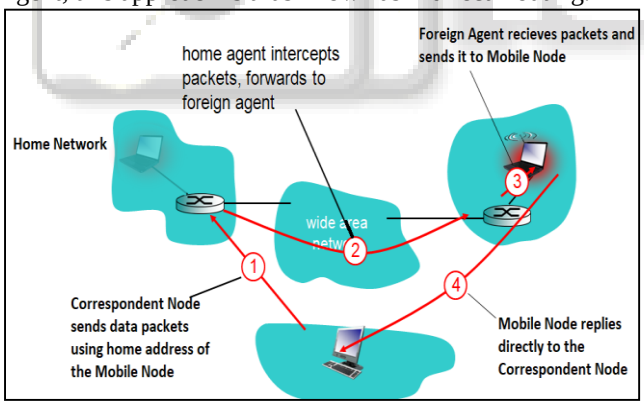

Fig. 2: Mobility via Indirect Routing

2) *Direct Routing:*

In this approach the Correspondent Node, instead of sending data packets to the Home Agent, requests for the Foreign Address of the Mobile Node from the Home Agent. The Home Agent provides the Correspondent Node with the Foreign Address of the Mobile Node. The Correspondent Node then forwards the data packets directly to the Foreign Agent which, in turn, forwards those packets to the Mobile Node. The Mobile Node replies directly to the Correspondent Node. Since, no data packets goes through the Home Agent thus this approach is known as Direct Routing.

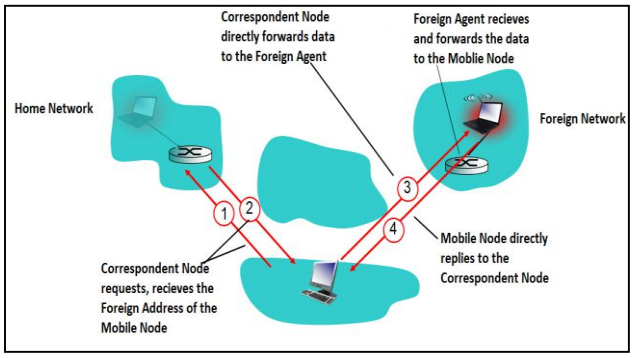

Fig. 3: Mobility via Direct Routing

IV. Three Phases of Mobile IP

In order to communicate with the Correspondent Node, a Mobile Node goes through three phases: Agent discovery, Registration and Data transfer. The first two involves Mobile Node, Foreign Agent and the Home Agent. In the data transfer phase, the Correspondent Node is also involved. These are discussed and demonstrated as under:

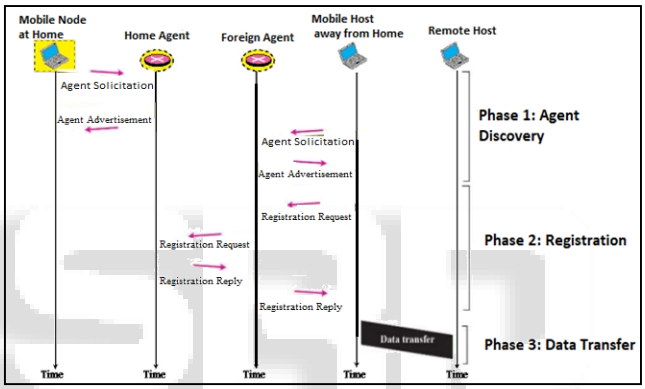

Fig. 4: Three phases for remote host and mobile host communication

A. *Agent Discovery:*

It is the principal stage in mobile communication. Agent discovery comprises of two sub phases. A versatile host must find a Home Agent before it leaves its home system. A versatile/mobile host should likewise find a Foreign Agent after it has moved to an outside system. This discovery comprises of learning the Care-of address as well as the foreign agent's address. The revelation includes two kinds of messages: advertisement and solicitation.

1) *Agent Advertisement:*

Mobile nodes use agent advertisements to decide their present point of connection to the Internet or to an association's network. An agent advertisement is an Internet Control Message Protocol (ICMP) router advertisement. A Foreign Agent can be too occupied to even think about serving extra Mobile Nodes. Be that as it may, a Foreign Agent must keep on sending agent advertisements. This way Mobile Nodes that are, as of now, enlisted with it will realize that they have not moved out of scope of the foreign agent and that the Foreign Agent has not fizzled.

2) *Agent Solicitation:*

When a Mobile Node has moved to a Foreign Network and has not received agent advertisements, it can initiate an agent

solicitation. ICMP solicitation message can be used by the Mobile Node to inform an agent that it needs assistance.

B. Registration:

It is the second phase in the mobile communication. After the Mobile Node has moved to a Foreign Network and discovered the Foreign Agent, it must register now in order to execute mobile communication. Registration includes four aspects;

- Mobile Node must register with the Foreign Agent.
- Mobile Node must register with its Home Agent.
- If the registration is expired it must be renewed.
- When the Mobile Node returns home it must deregister.

The registration phase involves registration request and registration reply.

1) Registration Request:

This request is sent from the Mobile Node to the Foreign Node in order to register its Care-of-address. The Mobile Node also advertises its Home address and Home Agent. After receiving the request the Foreign Agent forwards the same to the Home Agent. Home Agent knows about the Foreign Agent's address because the request forwarded by Foreign Agent in the form of IP packet uses IP address of the Foreign Agent as the source address. The registration request includes fields like; Type, Flag, Home Address, Home Agent Address, Care-of-address, Identification, Lifetime and other extensions.

2) Registration Reply:

A registration reply is first sent from the Home Agent to the Foreign Agent which is then forwarded to the Mobile Node. The registration reply may be either accepted or rejected. The fields are same as that of registration request but the value of Type field is 3 and the Flag field is replaced by the Code field which shows the result of the request (either accepted or rejected).

Registration messages are encapsulated inside a UDP user datagram.

The process can be shown by taking Home Agent address say 128.119.40.7, Care-of-address say 79.129.13.2 and Mobile Agent say 128.119.40.186.

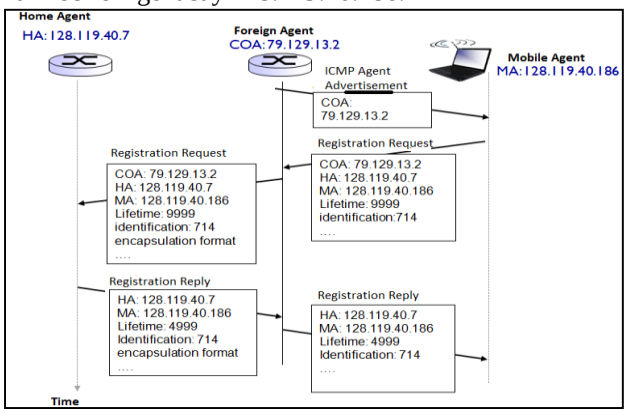

Fig. 5: Mobile IP Registration

C. Data Transfer:

After both the phases i.e. agent discovery and registration are successfully set a Mobile Node can communicate with the Correspondent Node. Data transfer is of the following types;

- From Correspondent Node to the Home Agent: When a Correspondent Node wants to send any data packet to the Mobile Node it will use its own address as the source address and the home address of the Mobile Node as the destination address.
- From Home Agent to the Foreign Agent: When the Home Agent receives the packet it sends the same to the Foreign Agent using the tunnelling technique. The IP packet received by the Home Agent is encapsulated inside another IP packet in which Home Agent uses its address as the source address and the Foreign Agent's address as the destination address.
- From Foreign Agent to the Mobile Node: When the encapsulated IP packet is received by the Foreign Agent, it extracts the original IP packet. Since the destination address is the home address of the Mobile Node, the Foreign Agent checks in the registry table in order to find the Care-of-address of the Mobile Node. The packet is then forwarded to the Care-of-address.
- From Mobile Node to the Correspondent Node: The Mobile Node replies directly to the Correspondent Node. The Mobile Node sends reply as a packet with its home address as its source address and Correspondent Node's address as destination address.

V. Advantages of Mobile IP

The introduction of Mobile IP has allowed the hosts to move at will between wireless connection areas. The advantages linked with the invention of Mobile IP are;

- It permits fast, continuous low-cost access to corporate systems in remote regions where there is no open phone framework or cell inclusion.
- It underpins a wide scope of uses from Internet access and e-mail to e-commerce.
- Users can be for all time associated with their Internet supplier and charged distinctly for the information bundles that are sent and received.
- Lower hardware and use costs for those requiring dependable high-speed information associations in remote areas around the world.
- A client can take a palmtop or PC without losing the association with the home system.
- Mobile IP discovers nearby IP switches and interfaces naturally. It is phone-jack and wire-free.
- Other than mobile hubs/switches, the rest of the switches and hosts will even now utilize current IP. Mobile IP leaves transport and higher conventions unaffected.
- Authentication is performed to guarantee that rights are being ensured.
- Mobile IP can move starting with one kind of medium then onto the next without losing availability. It is one of a kind in its capacity to suit heterogeneous mobility in addition to the homogeneous mobility.

VI. Issues in Mobile IP and their Rectifications

There are some of the inefficiencies related to the Mobile IP. Some of the major issues are described as under;

A. Double Crossing:

Double Crossing happens when a Remote/Correspondent Node corresponds with a Mobile Node that has moved to a

similar network as the Remote Node. At the point when the Mobile Node sends the data packet to the Remote Node, there is no wastefulness; the correspondence is nearby. But when the Remote Node sends the data packet to the Mobile Node, the packet travels the Internet twice. This involves wastefulness and this wastefulness from double crossing is noteworthy.

B. Triangulation Problem or Triangle Routing:

A less serious case, it happens when the remote host corresponds with a versatile or mobile host that isn't appended to a similar system as the mobile host. At the point when the versatile host sends a packet to the remote host, there is no wastefulness. However, when the remote host sends a packet to the portable or mobile host, the packet goes from the remote host to the home agent and after that to the mobile host. The packet ventures to every part of the different sides of a triangle rather than only one side.

1) Solution;

a) Optimization of the Route:

Optimizing route expansions to Mobile IP which have as of late been proposed would enable a Correspondent Node to be educated regarding the Mobile Node's care-of address so it can send data packets legitimately to it. At the point when a Correspondent Node sends data packets to a home agent for tunneling to the Mobile Node, the home agent can accept that the Correspondent Node is uninformed of the Mobile Node's present Care-of-address. In the wake of tunneling this data packet for the Correspondent Node, the home agent sends a validated Binding Update to the Correspondent Node, encouraging it to refresh its Binding Cache with the Care-of-address of the Mobile Node it is sending data packets to. This binding cache contains mappings from home addresses to the Care-of-addresses. Every section is determined to be legitimate for a measure of time which is equivalent to the time the node is enlisted with the home agent. When a Correspondent Node refreshes its binding cache it can tunnel data packets straightforwardly to the Care-of-address.

C. Security Vulnerabilities:

This is also important issue to address as to how Mobile IP can be secure when in correspondence with the Internet. There are many Internet vulnerabilities like Packet Sniffing, Denial Of service and Hijacking of the session. Even though, route optimization is useful but it also introduces many other security vulnerabilities.

1) Solution:

These threats can be handled using the techniques like Key Management, Authentication, Firewalls, Auditing which include Intrusion Detection System (IDS), by using trusted servers, more emphases should be given towards tunneling rather than routing, using IPSec (Internet Security Protocol).

VII. Conclusion

Mobile IP is a recently characterized convention which supports portable clients yet additionally is good with the present IP. It is still during the time being institutionalized, and there are as yet numerous things that should be dealt with and upgraded, for example, the security issue and the routing issue. The expanded client accommodation and the decreased requirement for application attention to mobility can be a noteworthy main thrust for its appropriation. It has been shown in this paper that even with the constraints that are available in the execution of Mobile IP, there will be a higher requirement for Mobile IP later on. To sum it up all, it is smarter to express that Mobile IP gives network correspondence a dynamic appearance.

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