Mobile IP and Comparison between Mobile IPv4 and IPv6

Prachi
Associate professor, CSE&IT Department, ITM University, Gurgaon, India

Nikita Jora
CSE&IT Department, ITM University, Gurgaon, India

Abstract - *Mobile* IP is a communication protocol defined by Internet Engineering Task Force (IETF) standard. Mobile users use mobile IP to ensure continuous Internet connectivity without bothering about their dynamic location. It is a widely used protocol in mobile environment that supports encapsulation and standard routing mechanism. This paper includes features of Mobile IP along-with its need, operations and problems. Specific details of Mobile IPv4 and Mobile IPv6 are also discussed. Further, we discuss role of mobile IP in Cloud Computing because Cloud Computing is one the most emerging trends in IT Industry. Later on, comparison between Mobile IPv4 and Mobile IPv6 is performed in order to highlight similarities and differences.

Index terms - mobile ip, ipv4, ipv6, computing, CoA.

1. INTRODUCTION

The Mobile IP decorum allows routing of IP packets on the Internet with location independence. A mobile node is recognized with the help of its IP address hiding its present position on the Internet. Mobile intercommunication services are experiencing noticeable growth and are furnishing Internet access from various mobile endpoints on which users are regularly increasing every day. When the mobile node is present in foreign network, it is accompanied with a COA (care-of address) that encloses information about its current position and home address.

The greatest challenge was the number of increasing users with variety of services and mobile devices on a wireless communication when moving from home area network to the foreign network. In such a situation, the mobile node also interacts with the home network. Researchers came to conclusion that IP layer has importance for mobility [1].

Assuming that a mobile node enters a foreign network with information about its home address and the new point of attachment is not reflected, continued with this the router cannot send the datagrams properly. Therefore mobile node must reconfigure different IP address but assigning a different address is difficult to handle. Thus, according to current IP if mobile node changes its location without changing IP address, it loses routing. If it changes IP address then it loses connections. It enables the computer to travel freely on the internet or an organizational network although preserving the home address.

Before conceptualizing the Mobile IP, it is essential to introduce 'Computing Mobility' for future perspective which allows some user to complete his/her computational tasks up to some extend which can be preceded via Personal/Terminal Mobility. From Personal computing point of view user can't change its terminal point but have an IP session which delivers services as per home network's services. And from the ways of Terminal point can change its terminal based on entity it's belonging to without informing the network in which it's working.

Here we evaluate the performance of Mobile IP network and

try to find the use of Data Link layer with the purpose of decreasing packet loss and handover delay enhancing response time. The network is modified with the new location. Following figure depicts a general Mobile IP network.

1.1. Terminology

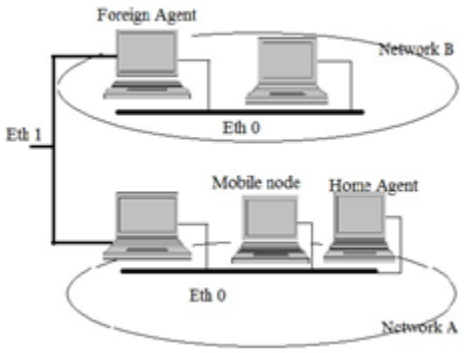

Figure 1 Mobile IP Network

Some of the terms needed for better understanding of Mobile IP are:

- Mobile Node (MN): It is a terminal system that alters its point of connection to the internet with the help of Mobile IP. It maintains its IP address and sets up

connection with any network on the internet with the help of link- layer connectivity.

- Correspondent Node (CN): It is the partner needed for communication with MN. It can be mobile or immobile.
- Home Network: In accordance to its IP address, the MN co-occurs with a subnet called the Home Network. Mobile IP indulgence is not needed when MN is present in its home network.
- Foreign Network: The foreign network is the prevailing subnet that the MN enters when it is not present in its home network.
- Foreign Agent (FA): It provides various services to the MN while it visits a foreign network. It also has the COA that acts as one end of the tunnel and moving packets to the MN.
- Home Agent (HA): It supports various services for the MN and is based in the home network. HA is the starting point of tunnel for packets toward the MN. It maintains a location registry.
- Care- of Address (CoA): It is used to determine the present location of MN according to the IP. All packets that are to be sent to the MN are handed over to the CoA.

1.2. Features of MobileIP

The following features have a great significance in wireless communication:

No geographical limitations and physical connectivity is required. Mobile IP supports security and there is no need for the modification of IP Address.

Factors having a great influence on the need for Mobile IP:

- Improvements in the Mobile IP technique:
  - Mobile IPv6
  - Hierarchical Mobile IPv6 (HMIPv6)
- Mobility support as there are increased number of Mobile users.
- It works according to the standards i.e. Current IP protocol.
- Inter-operability, which means that different service providers can use this protocol.
- Lack of alternatives as there are limited technologies.
- There is limited availability of IPv4 addresses.
- There's security improvement as registering the address with home agent gets secured.

1.3. Need of mobile IP

Mobile IP is an important perspective in today's environment. In early times, fixed point telephones were used. Wired phenomenon limits mobility of users. As a result, consumers started migrating to modern cellular or mobile phones that are wireless in nature so that users can easily move from one network to another.

However, wireless again comes with some drawbacks such as no network coverage and prohibitive cost.

It is clear from the above discussion that mobile computing technology will become more popular in the future. Mobile devices with Internet access are currently being used by with consumers [2].

Some important advantages of Mobile IP have been discussed below:

- Devices offer location independent access to services.
- Ease of operability (user can access services from anywhere).
- Economical in nature because there is no cost of wiring and maintenance as in wired.
- Wireless network services.
- Reliable and continuous connectivity.

Some examples can be seen where need of mobile IP is considered very important:

- Collaborative office issues: Employees can interact with each other on personal level. Moreover, it allows them to share information.
- Hospitals: Patients can share reports on the internet with doctors and they don't have to visit the doctors in case of an emergency.
- Military operations

1.4. Basic Operations

Mobile IP works on the basis of three operations:

- Agent Discovery: In Mobile IP, there are two ways for finding a foreign agent: agent advertisement and agent solicitation. In case of an agent advertisement, the foreign agents and home agents announce their presence regularly with the help special messages. Agent solicitation is sent by the MN if no agent advertisements are present or the inter - arrival time is too high. This way, the MN acquires a CoA.
- Registration: Once the CoA has been Acquired, the MN must register with the Home Agent to intimate it of the present location of the MN for future packet delivery. Registration of

the mobile node can be done via FA or directly with the HA.

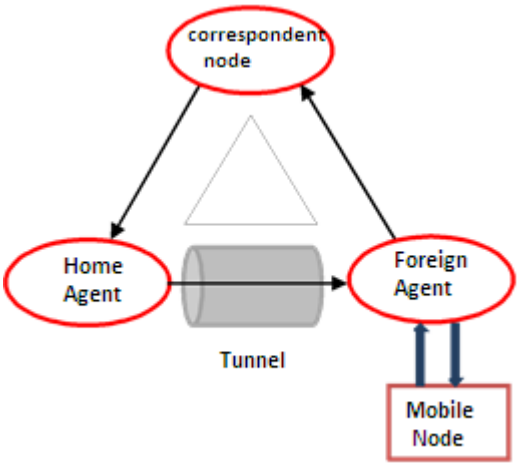

Figure 2 Tunneling and encapsulation

- Tunneling and Encapsulation: A tunnel is a virtual pipe for the movement of data packets between its entry and endpoint. Encapsulation is the mechanism of wrapping up of header and data of one packet and embedding it in the data section of the upcoming packet. These are used for moving data between HA and CoA.

1.5. Problems in Mobile IP

There are majorly four problems:

- Triangle routing [3]: Although mobile node transfers packets undeviatingly to the corresponding node but the corresponding node has to take a longer path. The packets are dispatched to the mobile node via home agent. The path followed from CN to FA is comparatively longer causing redundant routing.
- Handoff problem: It indicates that Home Agent (HA) send IP packets to the mobile node via the tunneling to its previous foreign network because it has no idea of the latest Care of Address (CoA) of the Mobile Host. At the time of initiating, the HA is unaware when the Mobile no de-evacuates the original foreign network and when a new registration address of the MH will be received by the HA. As a consequence, the IP packets lost during this time have an impact on the communion between the Mobile Host and the corresponding host. The impact is major when handoffs occur very often.
- Intra- Domain Movement Problem: If the MN frequently moves within the intra- domain, large number of handoffs occurs. This leads to the accumulation of large amount of registration messages and the performance of the system is reduced.
- Quality of Service Problem: Due to the ebullient behavior of the wireless network, it is very difficult to maintain QoS over Mobile IP.

2. MOBILE IPv4

In Mobile IPv4, a node that receives the data packets resides on the specific network designated to it by its corresponding IP address. To accomplish this, either the IP address of the node should be changed whenever its location changes, or the HA must have a wide routing network over the internet. Both are not much feasible.

By default the tunnel present between CN and FA is unidirectional. To optimize this problem, one way is to use binding cache for caching the current location of MN for CN. Mobile IPv4 also uses reverse tunneling to force the traffic through the HA in both forward and backward directions.

Further there are some problems to be resolved and IETF is still working on it in order to have sophisticated protocol. the problems are: Redundant fields in “IP within IP” as IP is enveloped into another IP header which increases the overhead, another problem is Fragility which explains the disadvantage of having single home agent; we can have multiple home agent for proper functionality, another one is Dogleg Routing which is due to indirect routing when sending the packets to correspondent node within the sub network.

3. MOBILE IPv6

Mobile IPv6 has several advantages over version 4. Mobility support mechanisms are an integral part of IPv6. All nodes of IPv6 require authentication as a security check. They are also incorporated with built in mechanisms for acquiring a CoA along with neighbor discovery. This facilitates every node to generate or obtain a geographically correct address.

Basically it is figured out to indicate the time incurred during the performance of the mobility and tunneling of the packets and it also calculates the delays for example internet or intranet delays and also analyses some parameters which can be very helpful such as Percentage of additional routing time plus the percentage of encapsulated packets.

In IPv6, the nodes can bind updates to each other. Also, a soft handover takes place in this version, enabling the MN to send its new CoA to old router in order to receive all packets at new CoA going forward.

FA is not required in IPv6. A CN only needs to process binding updates. However, it continues to face the problems regarding firewall or privacy.

4. MOBILITY WITH CLOUD COMPUTING

The emergence of cloud computing concept with the Mobile connections proved to be very effectual in terms of data security as this technology confirms an unparalleled platform for organizations accommodating enterprise mobility solutions.

This technology enhances the mobility by not using personal devices but having the shared computing resources to have better and secure communication for such applications without compromising unauthorized access to some beneficial information and user's location.

Leveraging cloud computing solutions with Mobile IP is a great advantage for companies having their own computing abilities cutting out edge technology and providing scalability, reliability, empowerment of employees and some real time issues and updates.

5. COMPARISON OF MOBILE IPv4 AND IPv6

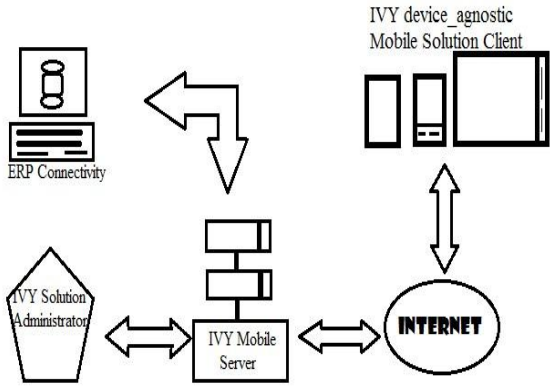

Figure 3 Mobile with cloud computing

In this section, we will discuss some of the major differences between Ipv4 and Ipv6.

While IPv4 uses encapsulation for sending packets to mobile nodes, in IPv6, the packets are tunneled using routing header. This requires less byte to be added to the data, thus, reducing overhead.

- In IPv4, FAs are used in the process of packet delivery to a mobile node. Such is not the case in IPv6. It uses neighbor discovery and address auto configuration.
- IPv6 lacks important features such as high speed handover or paging. These are considered as eminent part of wireless network.
- There is a prominent difference in the way IP addresses are represented in both the versions. In IPv4, each 1 byte decimal number is separated by dot (.) while IPv6 uses hexadecimal numbers separated by colons (:).
- The length of address in IPv6 is 128 bits long whereas in IPv4, the address consists of 32 bits.
- If chosen, IPv6 can bear larger payload than the rigid size in IPv4.
- IPv4 is dependent on its own security procedures during the complete process whereas IPv6 uses the IP security for protection and authentication of data at every step.
- IPv4 faces the problem of "triangle routing". This problem has been eliminated in IPv6 with the help of route optimization.
- In mobile IPv4 HA uses ARP to block the message for mobile node. In case of IPv6, the messages are intercepted using neighbor discovery.

6. RELATED WORK ON MOBILE IP

Usually, when mobile node proceeds to a foreign network, FA sends or broadcast the IRDP (internet router discovery protocol) message periodically within its own network to enable the visitor to know what services this network provides.

Specifically, there are three types of authentication while registering [4]: between HA and MN (Mobile- Home) or between MN and FA(Mobile-Foreign) or between HA and FA(Foreign- Home), where key for authentication is HMAC-MD5 (Key-hashed message authentication code with Message-Digest algorithm 5). It's a shared key and prevent mobile node from knowing whether it is a FA or HA.

Author later proposed two algorithms: First algorithm uses Lifetime field in ICMP header for registration. Second algorithm uses network prefix feature of prefix length extension which is a part of agent advertisement protocol.

Since ICMP messages are slow, therefore to make mobility detection rapid [5] authors contemplated ideas so that Layer 2 information can be combined with agent solicitation message which states that whether a mobile node should be handed off or not [6].

With route optimization, packet loss problem has been addressed. Additionally, authors emphasize on smooth handoff [7].

Using this buffer scheme mechanism (route optimization)[8], a mailbox-based strategy was announced, which surpasses above scheme as instead of MN, mailbox got the message directly.

It was suggested the Fast Hand Off procedure which controls the packet loss and delays over handoff in 2006 [9]. Exclusion from mailbox-based scheme, the regionalized

registration approach was used, where gateway is present for every domain.

Later IP-in-IP encapsulation and Minimal encapsulation were introduced. A third category of encapsulation was devised i.e. The Generic routing encapsulation (GRE) with the auspicious enhancements to the developments mentioned above. Due to this, one problem occurred that is Triangle Routing for which recommended technology was Reverse Tunneling technique [10].

A procedure called route optimization was used for binding cache to store address and COA with the help of binding message mechanism.

The QOS services in Mobile IP described some of the QOS Extensions for the development of Mobile IP:

- IntServ,
- DiffServ and
- MobileIP-Specific MPLS Formulation.

The Mobile Multicast (MoM) scheme essentially pick out one HAs (home agents) as the DMSP (designated multicast service provider) and using it multicast packets can be sent to mobile nodes.

Authors described various types of probable intrusions and suggested explications to these problems [11].

Some correlated schemes defined above for multicasting where Bi-directional multicasting providing better security whereas remote subscription beats all the techniques. It was declared RBMOM (Range based Mobile Multicast Protocol) which is a combination of Remote subscription and bidirectional tunneling.

Another major technique was introduced which is mobile multicasting gateway (MMG) to replace mobile home agent (MHA). MMG works as both mobile IP and multicast which remove the overload of tunneling and route optimization.

The feasibility of extending the internet telephony over mobile IP was examined. The author did a survey on security of mobile IP and also proposed secure mobility support system with the use of IPSec [12].

The evaluation of MobileIPv4 and mobile IPv6 was done in terms of handoff latency performance and the total performance relies upon frame error rate which is reduced by Adaptive Retransmission Timer scheme.

Most recently the two procedures were introduced to enhance handoff performance,

- One is the scalable QOS provisioning scheme (SQPS) which is based on location tracking and advanced resource reservation so as to prevent packet loss during handoff.
- Second is Low-latency Guarantee Handoff

  Scheme (LHSQ) which declines the rate of packet loss and is better than the former option.

A new scheme was introduced which optimizes the header caching for packet transfer process and also reduces delays by using low latency LHSQ [13].

Some implications of Retransmission timeout on Transfer Control Protocol performance were presented. The authors simulated the fallout of TCP flavors over the throughput of FTP data on a WLAN and examined way to enhance TCP Vegas efficiency after handoff [14].

Later the evaluation of TCP performance was done in points of dropped packets and management of maintaining the acquaintances for a long period and signaling between corresponding node and MN on Mobile IPv4 or Mobile IPv6 [15].

Various IP-related mobility protocols were surveyed and comparisons were done over handoff latency, signaling overhead and location update. The protocols are: Cellular IP, Mobile IP, Hawaii, dynamic mobility agent, TELEMIP etc.

A protocol called Internet Mobile Host Protocol (IMHP) was defined which concludes both: authentication of information from outside users and route optimization but still security is its disadvantage [16].

The problem of the firewall traversal inefficiency was covered by the author, who introduced the Solaris Mobile IP. Despite of the name (Solaris), system is executed on LINUX OS [17].

Mosquito Net research mob created this implementation of Mobile IP which states that there is a lack of FA in Linux Operating system, instead of this it uses co-located COA. Security for the Mobile IP was provided by The Portland State Secure Mobile Networking Project.

To ameliorate the speed and security of Linux kernel, tunneling is proposed. During this research work was represented a hierarchical type (Dynamic MIP for Linux). This led to Cellular IP which is suitable in situations where mobile node changes network frequently.

Some of the companies which support MIP are: Nokia, Cisco, Hewlett-Packard and some of the MIP client service providers Secgo and ipUnplugged, 2005 [18-20].

7. CONCLUSION

Followed by the above introductory part, it has been a great commencement of Mobile IP which will ultimately be advantageous and a remarkable encouragement for worldwide to bring wireless data communication into regular use. The important principle of Mobile IP is to provide

seamless participation in developing support for routing of IP nodes using either protocol IPv4 or protocol IPv6. There are a lot of references which prove that Mobile IP is a big deal and is highly concerned. Various surveys and researches have been done and still going on in this field as a recent search has been revealed on IETF website. Researchers are also working to initiate platform for mobile networking with support from Mobile IPv6 between entire subnets. For example NEMO (Network Mobility) which has been a supporting protocol. For arrangement of both IPv6 and mobile networking, it is time to make it possible to have IPv6 in continuation with future needs and aspects .As per our view, like IPv4, IPv6 should also have an easy perpetuation according to the procedures followed with IPv4.

REFERENCES

[1] Charles E. Perkins, "Mobile IP", IEEE Communications Magazine, May 1997.
[2] Kunal Ganguly, "A Study Of Mobile IP", Department Of Computer Science, Wichita State University, Wichita, Kansas 67260, USA
[3] Khaled Mahmood Al-Adhal, Dr. S.S Tyagi "Mobile IP: A Study of Issus, Challenges, and Comparison of Ipv4 & Ipv6", International Journal of Engineering Research and Applications (IJERA), Vol. 2, Issue 6, November- December 2012, pp.616-621.
[4] Charles E. Perkins, S. R. Alpert, B. Woolf "Mobile IP," Design Principles and Practices, Addison-Wesley Longman Publishing Co. Inc. Boston, MA, USA ©1997
[5] Stefan Raab and Madhavi W. Chandra, "Mobile IP Technology and Applications," Cisco Press networking technology series, Cisco Press, 2005.
[6] Liu Yu, Ye Min-hua, and Zhang Hui-min, "The handoff schemes in mobile IP". The 57th IEEE Semiannual Vehicular Technology Conference, 2003. VTC 2003-spring, 22-25 April 2003, 485-489, Vol. 1.
[7] Rajeev Koodli and Charles E. Perkins, "Mobile IPv4 Fast Handovers", Internet Draft, Internet Engineering Task Force, February 2006
[8] Jiannong Cao, Liang Zhang, Henry Chan, and Das, S.K,"Design and performance evaluation of an improved mobile IP protocol", Twenty-third AnnualJoint Conference of the IEEE Computer and Communications Societies INFOCOM 7-11 March, 2004.
[9] Rajeev Koodli, "Fast Handovers for Mobile IPv6," Internet Draft, Internet Engineering Task Force, draft-ietf-mipshop-fast-mipv6-03.txt, October 2005.
[10] Charles E Perkins "mobile ip for host mobility" Internet RFC 2002, October 1996.
[11] J. D. Solomon, "MobileIP - The Internet Unplugged," Prentice-Hall, 1997.
[12] Rafiqul Islam, "Enhanced Security in Mobile IP Communication," MSc Thesis, Department of Computer and System Sciences, Royal Institute of Technology, Sweden.
[13] Min Wang and Geng-Sheng (G.S.) Kuo, "Enhancement of voice over mobile IP for infrastructure-mode wireless LANs", Global Telecommunications Conference, 2005. GLOBECOM '05. IEEE, 2-2 Dec. 2005, pp. – 2646-2650.
[14] Cheng-Yuan Ho, Yi-Cheng Chan, and Yaw-Chung Chen,"An efficient mechanism of TCP-Vegas on mobile IP networks", INFOCOM 2005. 24th Annual Joint Conference of the IEEE Computer and Communications Societies. Proceedings IEEE, 13-17 March 2005, pp.: 2776 - 2780 vol. 4.
[15] Sujeong Chang, Jaehyung Park, Yonggwan Won, Mijeong Yang, and Min Young Chung, "Performance Comparison of TCP Traffic over Mobile IPv4 and IPv6 Networks and a Mobile Network Deployment Approach,", The Fifth International Conference on Computer and Information Technology, 21-23 Sept.2005, pp. 469-473.
[16] Charles E. Perkins, Andrew Myles, and David B.Johnson, "The Internet Mobile Host Protocol (IMHP)," Proc. INET '94 / JENC5pp. 642-1 -642-10.
[17] Vipul Gupta, "Solaris Mobile IP: Design and Implementation," SUN Microsystems, Inc. Palo Alto, CA 94303-4900. February 17, 1998
[18] Nokia," Mobile VOIP: IP Convergence Goes Mobile".
[19] Hewlett-Packard,"HP-UX Mobile IPv4 A.02.01", March 2003.
[20] BirdStep,"Birdstep Intelligent Mobile IP Client v2.0", Universal Edition.

Authors

Ms .Prachi Ahlawat is Ph.D. holder in Computer Science from the Banasthali University of Rajasthan, India. Her current research interests include wireless sensor networks, key agreement in wireless peer-to-peer systems and security in underwater sensor networks. Prachi received the B.Tech. degree from M.D. University, Rohtak in 2007 and the M.Tech. degree with distinction in Computer Science from the Banasthali University at Rajasthan in 2009. She is author of 21 refereed articles in these areas, 9 in peer reviewed; reputed international journal indexed in international databases and 12 in IEEE and Springer indexed International Conferences.

Ms. Nikita Jora is an M.tech student in Computer Science and Engineering at ITM University. She has keen interest in Mobile IP and Networking.