Mobile IP Implementation and Testing

PUI CHEN YUNG

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Abstract

Nowadays, computer science and information technology is growing rapidly. Computer science plays an important role in achieving the demand of resident. Data communications in computer science have provided many facilities and services to all people with the new technology used. Mobile IP is a technology standard which is applied in data communication networking. The standard of Mobile IP is developed to provide the mobility service and increase the flexibility and efficiency in telecommunication fields. The Mobile IP implementation is set up and tested to show the capability in communication. Mobile IP implementation and testing will be deployed by using the Dynamics HUT software distribution. Dynamics HUT group had developed their implementation which is fulfilled the characteristics needed in Mobile IP standard. The main feature of this system is to provide a test-bed for Mobile IP implementation and create the environment proving how Mobile IP works. This report will discuss the introduction of Mobile IP, background, requirement analysis and design, system implementation, testing and evaluation, and conclusion and future works.
Abstrak

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Chapter 1: Introduction

1.1 Introduction

This chapter is explaining about the overall goals and tasks of the project implementation. Here, the reason for this project is needed and its problem statement is clearly defined as project’s primary objectives. Then, the project scope and its methodology must propose properly to achieve to target that mentioned in the objectives. This part is also classifying the significant of project and showing how this project brings benefit to people in real life. Finally, the expected outcome will simply define to prove the important of this project.

1.2 About Mobile IP

Mobile IP is an open standard, defined by the Internet Engineering Task Force (IETF) RFC 2002. This standard enables transparent routing of IP datagram to mobile nodes in different networks including Internet (Perkins, C. 1996). Mobile IP allows users to keep the same IP address, stay connected, and maintain ongoing applications while roaming between IP networks (www.cisco.com). It is scalable because it is based on IP. Mobile IP was originally defined for IP version 4 (IPv4). Recently, because of the incompetent to meet the evolving communication scenario in Mobile IPv4, Mobile IP version 6 (IPv6) had been created. Mobile IPv6 shares many features with Mobile IPv4. However, Mobile IPv4 and the fully integrated Mobile IPv6 have provided an efficient solution for mobility environment. This standard improves and facilitates people’s data communication in mobility process by using their mobile devices.
1.3 Problem Statement

In traditional system structures of network computing, computers are typically configured for use in a single location. Most stationary computers are stay connected to a single network. The IP address between both end users is required in same subnet within its network during the connection. Users have to change the IP address when connecting to another network in different area. To connect to another network without changing IP address, users have to use special hardware like router or gateway to perform the specific routing. This will cause the inconvenience for those who work in rush hour and changing their location frequently such as salesmen, consultants, engineers, students and others. People like salesmen, students, and others can not have direct access continuously and freely in data communication to other networks. This trouble may waste their time and energy when they have to return to the stationary computers to communicate. The efficiency and the quality of their works are then been affected due to the inconvenience of communication.

1.4 Objectives

The main objectives for this project are:

- To provide the environment to support mobile host. A user with one mobile device in one network can accessible to another network. Mobile host can keep the same IP address when roam between networks with ongoing or following communications still reachable.
• To test the application of the data communication with mobile IP and network communication without mobile IP. Migration locality of mobile computing will be experimented and examination here.

• To identify and differentiate the capabilities and problems between both data communication using Mobile IP and data communication without using Mobile IP. The support of the new Mobile host IP name serve as address migration bring a lot benefits. The problems faced will be highlighted during the implementation.

1.5 Scope

Firstly, a test-bed for data communication using Mobile IP and without Mobile IP is built to test its applicability. In this state, the protocol requirements, agent discovery, registration, tunneling and routing consideration of Mobile IP will be tested and implemented.

Secondly, the capability and its problems of the Mobile IP used in data communication are identified. The application on the mobile devices is confirmed regardless of their location. Mobile nodes can move from one IP subnet to another subnet. Reachable connection between the Mobile nodes, Foreign Agents and Home Agents is identified together and work purposefully.
1.6 Methodology

The methodology used to implement this project is the System Development Life Cycle (SDLC) method:

Identifying the Problems and Objectives

Define the project goal, and understand project's problems and objectives clearly. Understanding the problem statement and identified them as the goal of this project. Plan the project schedule to purpose this project.

Determining the Information Requirements

From the problem statements and search more information to find out the most suitable solution. Searching and have a survey on the existing implementations and the related-work about the Mobile IP implementation.

Analyzing System Needs

Interface, algorithms, and software supported to implement this project must be analysis and considered. Study and analysis the technical review on the Mobile IP implementation is required to get the idea and experience of preparing the component needed to build the test-bed.

Designing the Recommended System

In this state, coding, testing and debugging will be prepared and completed. Based on the analysis phase, the implementation progress will design for next implementation part. The functionality of mobile nodes, Home Agents, and Foreign Agents is designed to build in link-layer network.
Developing and Testing the System

Documenting the software for standards-based protocol and then maintaining the system to implement the overall project. Compiling and executing the system in this test-bed will be done and the critical parameter of the system will be finalized for this project’s measurement.

Evaluating and Future Work

The capabilities and the problems occurred have to confirm and highlight before the project is closed. Project evaluation and the lessons learn is needed to found out if any problems occur or issues concern. The better solution or suggestion of improvement to the issues concern will be documented for the future work.

1.7 Expected Outcome

Users can connect to the different network by keeping its same IP address with Mobile IP protocol. Mobile user can control the communication parameters with their portable computers at any area as long as there is connection provided. In campus, students or master students can roam in foreign network to gain their resources easily and freely. Students can access to different network in different areas easily as their mobile devices move. With mobility in auto-configuration environment, data communications provide various mobile services and applications with effective supports that can facilitate students work and quality in UNIMAS. Applications supported may have email, real-time delivery of content, instant messaging, organizer, and so on.
1.8 Significance of Project

This project is important and useful to maintain network connections with existing hosts regardless of location. The main purpose is to solve the problem of data crossing networks or different subnet in other area. Users can experience with this testing of Mobile IP implementation which is area of growing interest nowadays. The end-system mobility can be supported while maintaining scalability, efficiency, and compatibility in all respects with existing multimedia application and internet protocols. Protocol tunneling and mobility management have been used to improve the capability of data communication today.

1.9 Project Outline

This section will introduce the overall task or progress that will do in each chapter. Chapter 1 is about the project plan which the problem statement, objectives, scope of project, significant of project and expected outcome will be explained clearly. Chapter 2 is talking about the background of the project. During the chapter 2, the survey and technical review on the existing works. The consideration of the parameters used between each implementation will take attention to find out the necessary measurement to build. Then, Chapter 3 is planned to start the project design. The implementation tools chose during the design to prepare to develop the Mobile IP test-bed. For Chapter 4, implementation work will carry out to implement the system for testing. And finally, chapter 5 will have to do the documentation after analysis the results of the testing and program executing.
1.10 Project Schedule

This project may need about two semesters to complete the overall tasks. 

There is about 108 days to finish and the project will start from 4/4/2005 until the estimating date on 31/3/2006. The project plan with activity on the node included the schedule is shown as below and the Gantt Chat can view in the appendix.

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Table 1 – Job duration
Chapter 2: Background Review

2.1 Introduction

In this chapter, a critical overview or research to the background of the existing Mobile IP implementations will be made. The background to the area of this investigation is critically analyzed and the context of problem will be established here. Besides that, the survey on literature review associated with problem context and the basic implementation requirement will be studied. From this chapter, the basis of Mobile IP implementations knowledge and development tools will be established to make clear and have better understanding about why this system is needed.

2.2 Background

2.2.1 What is Mobile IP?

Mobile IP is a protocol standard, defined by Internet Engineering Task Force (IETF) RFC 2002 (Perkins, C. 1996), that allows users to roam any different networks using the same IP address. Mobile IP is implemented with IP version 4 (IPv4) and then has been evolved to IPv6 to fulfil the efficiency of today’s data communication scenario. Mobile IP is known as scalable, transparency, and seamless solution for mobility because the IP used can be supported by any media (Perkins, C. 1996). So, Mobile IP will be a good solution for mobility communication.
2.2.2 Environment without Mobile IP

Before the existing of the Mobile IP, network architecture in data
communication has not yet enhance to the condition where direct connection of
mobile host is allowed in different network at different area.

Generally, same IP address is required along the life of both ends of TCP
connection. End users have to access to either Local Area Network (LAN) or
Internet within a single network, the fixed places like sitting room. This situation
comes out the problems of lack of freedom for each end user's communication
while they are forced to leave their local network area. Users have to change the
device's IP address to new IP address that suits to the new connected network.
Another way for users to connect to new network without changing IP address is
using the router or gateway for host-specific route via the network. But then,
problem is here, the connection in both ends in previous network will be terminated.

In other word, those end users will face to communication problem when
they change location. To satisfy this need, the proposed of Mobile IP is published
by the Internet Engineering Steeling Group (IESG) in November, 1996. Then,
Internet Engineering Task Force (IETF) proposed Mobile IP as standard solution
for mobility.

The problem of mobility without Mobile IP is shown in Figure 1. The
Mobile Node is required to remain the same IP address when changing the
appointment on network (www.cisco.com). So, there should be a solution using
Mobile IP to let the Mobile Node to connect to its home network which is shown below (www.cisco.com).

Figure 1 - Problem of Mobility in the Internet

Figure 2 - Solutions by Mobile IP
2.2.3 Environment with Mobile IP

With the existing of the Mobile IP, mobility problem can be solved as the way of routing configuration. The moving Mobile Node to determine location in either Foreign Network or Home Network can be done by the change of Care-of Address (Perkins, C. 1996). IP address for Home Address that is kept unchangeable is helped to stay the connection. Process of accessing other network becomes independent.

There are many types of wireless application system developed by using the Mobile IP. Those wireless applications sometimes have been called handoffs system because it is cordless networking using the mobile devices. All these types of handoffs are the related works of the Mobile IP implementation.

Nowadays, the examples of handoffs system are such as WLAN, Ethernet, Bluetooth, 2G, GPRS, 3G, and others are all available when applied by Mobile IP (www.cisco.com). Mobile IP enables seamless and transparent roaming in and between different networks with a mobile device such as laptop or PDA, cell phone, and others. Wireless Standard such as 802.11 networks like hotspots can be used in campus or library environment between floors and buildings. Mobile IP is required for mobile devices if there is implementation of the different hotspots-subnets within the wide area.

There is very common for the voice over IP since the Mobile IP is created. Wireless network has developed for voice application in various types included cell
phone and walky-talky. This system has improved a lot for people’s communication.

Besides, the mobile communication insides the vehicle is developed as part of network. Those vehicles can keep different applications to run seamless roaming in various types of wireless network technologies.

2.3 Literature Review

2.3.1 Network Architectural Entities

There are three main components must require for the Mobile IP implementation (Perkins, C., 1996): Mobile Node (MN), Home Agent (HA), & Foreign Agent (FA).

MN is a mobile host device such as laptop, PDA and cell phone with available software for network roaming. MN keeps the same IP address and changes its point of attachments to access different location (Perkins, C., 1996).

HA is always in home network tunnels the datagram to MN that is away from home network. HA will identify where the MN is located and maintain the information of current location of the MN.

FA is an agent on foreign network visited by MN that is away from the home network. FA provides routing services that delivering the datagram sent from HA to the MN by de-tunneling the packets (Perkins, C., 1996).
There is terminal known as Correspondent Node (CN) involved in this application but is not part of the system. It likes the third party that wants to communicate with MN across the Internet.

![Diagram of Mobile IP components and relationship]

**Figure 3 - Mobile IP components and relationship**

### 2.3.2 How Mobile IP works?

To handle mobility problem, Mobile IP consists two types of addresses. The first type of address is home address. This is a permanent, fixed address that used by MN as usual in home network. Second type is Care-of address which is provided to MN when roaming. This address is temporary obtained by MN and changes when move to other foreign network. According to the RFC 2002, Mobile IP functionality is defined in three main phases, Agent Discovery, Registration, and Tunneling which will be explained more below (Perkins, C., 1996).

#### 2.3.2.1 Agent Discovery

Agent Discovery enables MN to look for its network by agent’s advertisement message. This Agent advertisement uses ICMP Router Discovery Protocol message (Perkins, C., 1996) as advertisement to let MN find out whether it is connected to home network, foreign network or both. In order to wait for the
advertisement, MN can send out an agent solicitation (Perkins, C., 1996) to force to obtain a Care-of address immediately from FA. Agent Discovery is also important for movement detection and registration.

MN can either connect directly to the home network or roam to a foreign network. For the MN which is linked to foreign network, Care-of addresses can be obtained in two ways (Hammarstrom, J., 2002) before it can report to HA. Foreign Agent Care-of address and Co-located Care-of address.

Foreign Agent Care-of address (Perkins, C., 1996) is provided through its Agent Advertisement messages. With this Care-of address, FA decapsulates the tunneled datagram from HA and delivers them to the MN. It allows many MN to share the same Care-of address. For the Co-located Care-of address (Perkins, C., 1996), it is a local IP address obtained by external assignment mechanism such as DHCP. This address will connect with one of MN’s own network interface. This second alternative is used if there is no Foreign Agent present in the visited network. This is less suited because a new IP address is been used.

2.3.2.2 Registration

A way for MN to inform its current location is through registration (Perkins, C., 1996). To communicate to HA, MN can use the registration of Care-of address when it is in the foreign network. MN also can register directly to the HA without foreign network by using the Co-located Care-of address (Perkins, C., 1996). Two types of messages defined here are registration request and registration reply.
Registration request is sent by MN to its HA to inform about MN's current location. Mobility binding for that MN is created at HA. Then, the registration reply created by will return to MN. Here, mobility binding table will be setup by HA to map the MN. Lifetime requested or granted, agree on services, identification and authentication will be included in registration (Perkins, C., 1996).

### 2.3.2.3 Tunneling / Routing

The MN uses its home IP address to forward datagram. When HA received datagram from the Correspondent Node, HA will tunnels them toward the MN using the Care-of address. There are two primary functions in tunneling. Firstly, the encapsulated datagram is delivered to the tunnel endpoint, usually is foreign network. Secondly, the datagram reach to that endpoint which is MN by decapsulation from FA. Reverse tunneling is where FA tunnel the datagram from MN back to the HA to handle the problem of incorrect data flow in the IP network (www.cisco.com).

### 2.3.3 Security Consideration

Mobile computing has more security problems if compare to wired network. Any mobile device can connect to network via wireless link and some active attack may happen. Mobile IP provides authentication for security purpose between its components. Mobile IP by default is using MD5 checksum algorithm where the data sent is encrypted to get the checksum value (Hammarstrom, J., 2002). Communication between MN and HA must be authenticated by a shared secret. Communication between MN and FA, other with FA and HA can optionally be