DEVELOPMENT OF IPv6 NETWORK WITH LOCATION ASSISTED TRANSFER FOR REAL TIME APPLICATIONS

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ABSTRACT

An approach is presented to develop a system that has a location tracking mechanism to track the position of the mobile unit (such as WiFi enabled devices or PDA) so that a device switching can be done to switch session from one device to another in order to provide roaming in an IPv6 network. In this work an IPv6 framework will be formulated and set up as a read test bed. Meanwhile a location tracking mechanism will be developed and integrated into the IMS IPv6 network with real time application and soft switch module to ensure continuous multimedia communication in the Internet while roaming. The proposed location tracking will be based on Received Signal Strength Indicator (RSSI). An accurate Path Loss Exponent will be calculated based on the RSSI and accurate positioning will be determined for soft switching of devices. The IMS based on IPv6 network will be developed and integrate with the location tracking system. The location tracking will be purely software based with minimum hardware dependent.

1. INTRODUCTION

Mobile IP is an Internet Engineering Task Force (IETF) standard communication protocol. Mobile IP is a technology that allows a network node (Mobile Node-MN) to migrate from its "home" network to other network (Foreign Agent), either within the same administrative domain or other administrative domains while consistently maintaining a permanent IP address. The basic Mobile IP protocol also provided transparent routing of IP datagram on the internet. Transparent means that the applications work just as before, with no re-configuration or re-authentication is required. This can maintain transportation and higher-layer connections while the mobile node moving.

Currently, the internet network uses Internet Protocol version 4 (IPv4) but in this project, the Internet Protocol version 6 (IPv6) will be use. The main reason why IPv6 preferred because IPv6 provided much larger address space that allow greater flexibility in allocating address and routing traffic. The address in IPv6 is 128 bits long versus 32 bits address in IPv4.

This shows that the IPv6 address space. This shows that the IPv6 address space is extremely large and ten billion times as many addresses as IPv4 can support. Moreover, for network security architects, IPv6 is deployed in a secure manner from the outset rather than slowly migrating toward security, as happened with IPv4.

The Location tracking can be develop by many approaches such as GPS, Received signal strength (RSSI), Time Base System - Time of Arrival (TOA), Angle of Arrival (AOA), Kalman filter and many more. The best method of measuring the location tracking is using RSSI.

2. LITERATURE REVIEW

The basic network protocol suite for the Internet (and most Local Area Networks today) is TCP/IP, which is an acronym for Transmission Control Protocol (over) Internet Protocol. The Internet Protocol (IP) is the primary protocol in the Internet Layer of the Internet Protocol Suite and has the task of delivering datagrams (packets) from the source host to the destination host solely based on its address. For this purpose the IP defines addressing methods and structures for datagram encapsulation. In [2, 16] shows more details about TCP and IP architecture.

An Internet Protocol (IP) address is a numerical identification (logical address) that is assigned to devices participating in a computer network utilizing the IP for communication between its nodes. The role of the IP address has been characterized as follows: "A name indicates what we seek. An address indicates where it is. A route indicates how to get there" [15, 16].

There are two versions currently in used of IP which are the original designers, Internet Protocol Version 4 (IPv4) and the new addressing system, Internet Protocol Version 6 (IPv6) actively deployed worldwide

2.1 IPv6 details

With IPv6, the internet layer is changed dramatically, but the other layers remain essentially unchanged. IPv6 performs pretty much the same functions as IPv4, but in a more reliable manner, with larger addresses and more flexible and efficient packet headers. Figure 2.1 shows the different between IPv4 header and IPv6 header.

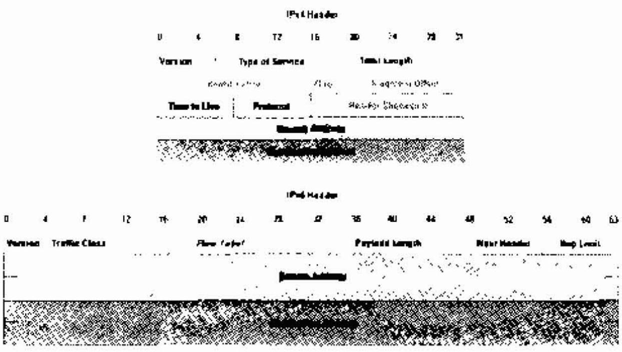

Figure 2.1: IPv4 Header and IPv6 Header

The designers of IPv6, the next generation of the Internet Protocol, aimed to replace IPv4 on the Internet [17].

2.2 Mobile IPv6 Operation

IPv6 has more addresses but these addresses do not solve the problem of mobility. Without specific support for mobility in IPv6, packets destined to a MN would not be able to reach the destination while the MN is away from its home network. Mobile IPv6 defines a new IPv6 protocol using the Mobility Header and also optimizes routing in Mobile IPv4. [10].

While away from home network, a MN registers its primary Care of Address (CoA) with a router on its home network, requesting this router to function as the HA for the MN. The MN performs this binding registration by sending a "Binding Update" (BU) message to the home agent for certain duration. HA stores the bindings in a special data structure called the binding cache. When the MN receives an initial packet tunneled by it's HA, it can determine whether the original sender of the packet is aware of its mobility. To inform CN of its mobility, MN will send a BU. With the binding, CN can then send datagrams directly to the MN's CoA by using a routing header. Figure 2.2 illustrates this procedure.

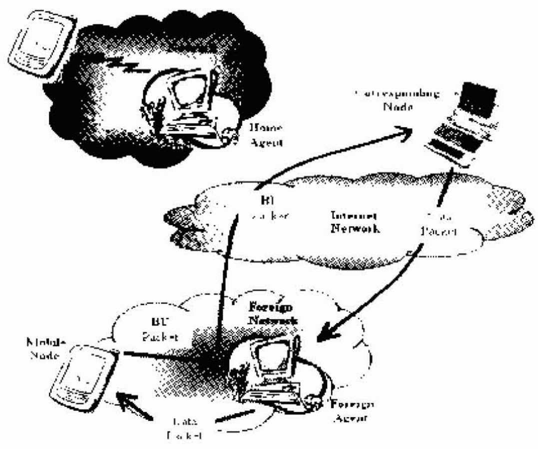

Figure 2.2: Mobile IPv6 Operation

As in [13, 14] there are two possible modes for communications between the MN and a CN. The first mode is bidirectional tunneling. This mode does not require Mobile IPv6 support from the CN. This mode as stated in [13, 14] is available even if the MN has not registered its current binding with the CN. For this mode, packets from the CN are routed to the HA and then tunneled to the MN. Packets to the CN are tunneled from the MN to the HA ("reverse tunneled") and then routed normally from the home network to the CN. In this mode, the HA uses proxy Neighbor Discovery to intercept any IPv6 packets addressed to the MN's home address (or home addresses) on the home network. Each intercepted packet is tunneled to the MN's primary CoA. This tunneling is performed using IPv6 encapsulation.

2.3 Location Tracking

The location tracking are always an issue in the Mobile IPv6 (MIPv6). There are many approaches in developing location tracking system. In [2, 6], the authors proposed mobility management scheme called Dynamic hierarchical Mobile IP (DHMIP) or Dynamic Domain Name System (DNS). DHMIP performs better than MIPv6 in terms of saving in signaling cost. But, it is not suitable for low call-to-mobility ratio (CMR). In [2] the proposal provides significant improvement over DHMIP for low CMR values, typically less than 1.

There are a lot of technique for location tracking or position determination such as using GPS, Received signal strength (RSSI), Time Base System - Time of Arrival (TOA), Angle of Arrival (AOA), and many more.

The RSSI, TOA and AOA, three this fundamental approaches to radiolocation system. For the GPS, although GPS receivers are increasingly cheaper to produce and becoming more widely available, they are still relatively expensive and power-hungry. Therefore, this project will developed location tracking without GPS system which the system more cheap, easy to develop, and stable using RSSI.

- **Received Signal Strength Indication (RSSI)**

  This approach used the relationship between the received signal strength and the distance. Theoretically there are an inverse proportional relationship between the received signal strength and the distance from the receiving station that can be represent linearly. For practical purposes, this technique involves determining the path loss function based on statistical analysis to overcome the various phenomena like multi-path fading and shadowing.

3. OVERVIEW

3.1 Overview of this project

This project, uses:
a) 2 workstations
b) A Switch or Hub
c) 3 mobile nodes (MN) in each network

Figure 3.1: Mobile IPv6 Network Island architecture

Two networks are used (A and B) in this project, uses IPv6 addresses. The router is started when one of the MN (let say as Bob) call another MN (let say as Allen) that exist in the same network or HA. Bob will wait for Allen to accept the call or reject the call. When Allen accepts the call, there will be communication between Bob and Allen

However it is getting harder when Allen have to move to another network (FA). In this project, when Allen moves to FA, the communication between Allen and Bob will be still reminds connected.

When Allen is already in the FA, Allen and Bob still connected and communicated to each other as before. Then, Allen is needed to transfer it communication (call) at other MN (nearest MN). Here, the location tracking takes part. When Allen press a button, then RSSI program will start to calculate the distance between all node around Allen. The nearest MN will be selected and the communication from Allen will be transmit to the nearest MN.

Lastly the communication or call from Bob still connected but at the nearest MN of Allen, not at Allen anymore.

3.2 The IPv6 Network

In this project, PC router is assured as Home Agent and PC router B is assured as Foreign Agent. The routers provide the network access to all MN around its boundary network. For setting up the router, Quagga software is used which is installed in Linux-Fedora environment.

Since the current network users IPv4, we had to create an IPv6 network Island. To build the IPv6 island network, programming had been developed to ensure connectivity between the node within the Island. Both routers should have the same programming. However the address used are different to separate the two networks.

3.3 Mobile Node (MN)

All the MN in the MIPv6 network Island are used Linux-Ubuntu OS. The mobile nodes must be connected to the PC Router A or PC Router B (Home Agent or Foreign Agent).

The network that connected is shows at the Essid's name.

3.4 Session Initiation Protocol (SIP)

In this project, for IPv6 part, we use the kphone as the software to connect two or more mobile node at the same times. Kphone is a SIP User Agent for Linux. It implements the functionallity of a VoIP Softphone but is not restricted to this. It is licensed under the GNU General Public License. Kphone is written in C++ and uses the Qt toolkit. Kphone supported many media types such as audio, presence information, instant messaging, video, and external application. The main features of Kphone are:

- IPv4 and IPv6 support
- Multiple parallel sessions (in the case of audio, o ne may be active, the others are held).
- user defined ring tones or "ring music"
- NAT-traversal and STUN support
- ALSA and OSS support

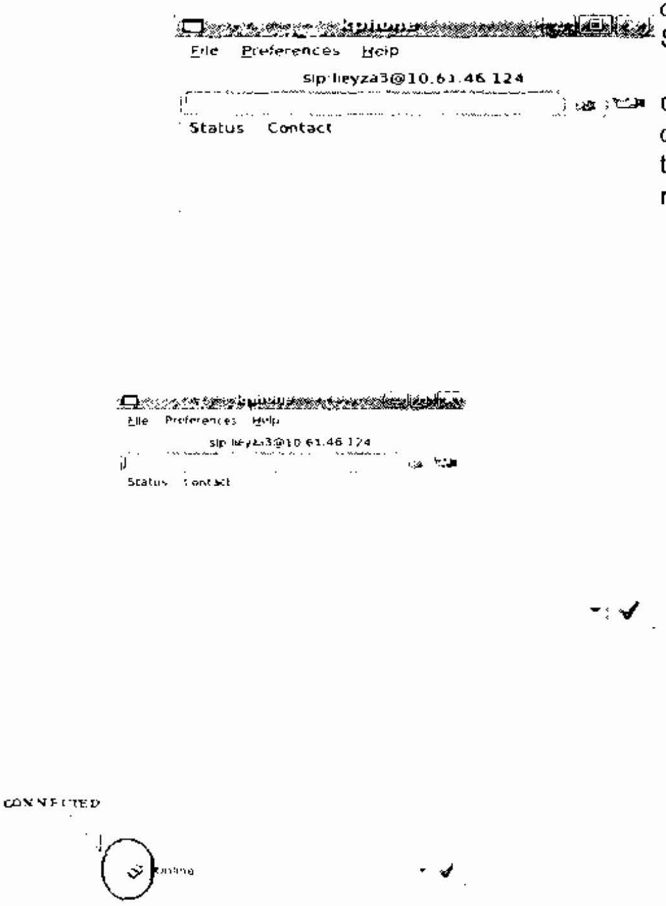

Figure 3.2: Example of the Kphone using IPv4

The approach to location determination is purely software based with minimum hardware system. Access Points (APs) are used to provide coverage to the whole building. The most important feature of this system is the ability to detect position of nodes indoor.

The location tracking IPv6 network model consists of a gateway, static APs and other Mobile Nodes. The gateway is the center of a Network Coordinate System (NCS) and the GUI program resides here. Mobile nodes devices in the network are laptops which are equipped with an Orinoco WaveLan PC card. The network interface card (NIC) operates in the 2.4GHz license free ISM band with data rate between 11Mbps and 1Mbps. Its coverage range for open, semi-open and closed areas are 160m, 50m and 25m respectively.

The location tracking or position determination of nodes in for location tracking is normally based on navigation system such as the radiolocation technique. The best fundamental approach of radiolocation system which depends on the electromagnetic signal parameter chosen for the position determination is Received Signal Strength Indication (RSSI).

The RSSI is potentially the best indicator for measuring distance. The accuracy of the estimated position depends on the accuracy of the range measurement. In this project the RSSI method is used to determine the position of mobile devices.

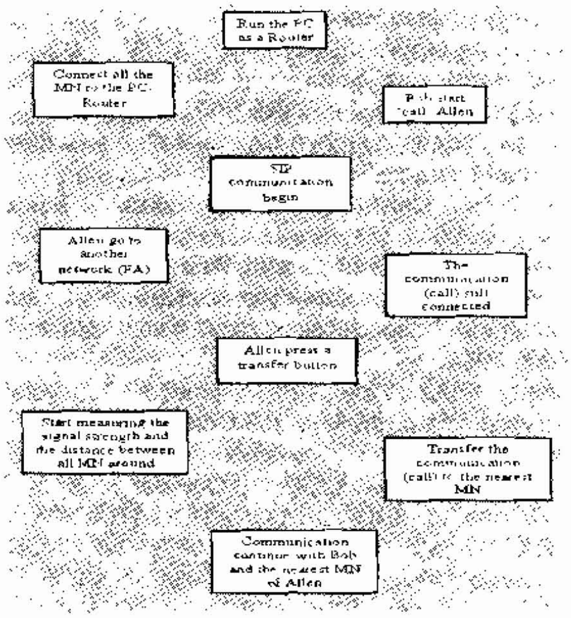

Figure 3.3 : Flow Chart

CONCLUSION

The aim of the project is to develop an Island network that has a location tracking mechanism such as to track the position of the mobile unit (such as WiFi enabled devices or PDA) so that the device switching will be able to switch session from one device to another in order to provide roaming in the IPv6 network. In this work an IMS IPv6 framework will be formulated and set up as a read test bed. Meanwhile a location tracking mechanism will be developed and integrated into the IMS IPv6 network with Session Initiation

Protocol (SIP) and soft switch module to ensure continuous multimedia communication in the Internet while roaming. The proposed location tracking will be based on Received Signal Strength Indicator (RSSI). An accurate Path Loss Exponent will be calculated based on the RSSI and accurate positioning will be determined for soft switching of devices

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