



- (51) **International Patent Classification:**
H04W 36/08 (2009.01) H04W 8/12 (2009.01)
- (21) **International Application Number:**
PCT/MY2009/000139
- (22) **International Filing Date:**
9 September 2009 (09.09.2009)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
PI 20083576 15 September 2008 (15.09.2008) MY
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- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) **Title:** A METHOD TO SPEED MOBILE IPV6 HANDOVERS BETWEEN INTERCONNECTED WIRELESS COMMUNICATIONS TERMINALS

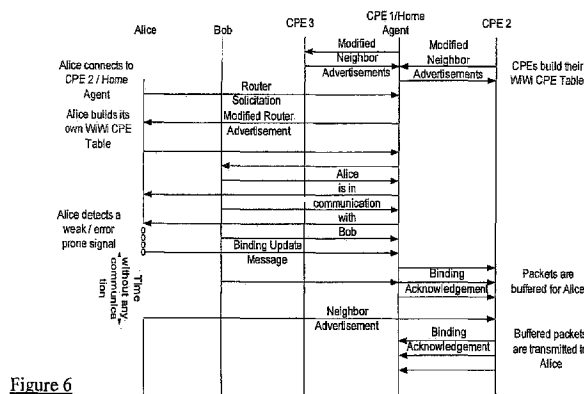


Figure 6

(57) **Abstract:** A method to speed Mobile IPv6 handovers between interconnected terminals in a wireless communication is provided herewith, wherein the connection to the future terminal is made prior to disconnecting the connection with present terminal.

WO 2010/030166 A1

A Method To Speed Mobile IPv6 Handovers Between Interconnected Wireless Communications Terminals

Field of Invention

This application relates to a fast Mobile IPv6 handover method for in wireless communication.

Background of Invention

Mobile Internet Protocol version 6 (IPv6) allows an IPv6 node to be mobile—to arbitrarily change its location on the IPv6 Internet—and still maintain existing connections. Connection maintenance for mobile nodes is not done by modifying connection-oriented protocols such as TCP, but by handling the change of addresses at the Internet layer using Mobile IPv6 messages and options and processes that ensure the correct delivery of data regardless of the mobile node's location.

A typical wireless communication based Mobile IPv6 scenario is depicted in figure 1. In this protocol when a mobile node decides to move to a new network due to the deterioration in signal in the present network, the mobile node will experience a indefinite handoff interruption that can last about 2 to 10 seconds. In real time applications this duration of interruption can be easily observed by end users as a break in communications. This is because when a mobile node detaches itself from its current network and attaches itself to a new network it has to wait a random amount of time and request for an IPv6 prefix advertisement.

Further to the above, the present protocol faces other problems such as

- a. Macro mobility nature of Mobile IPv6 protocol where Mobile nodes are assumed to travel long distances and thus the Mobile IPv6 protocol was designed to solve macro mobility, while in reality the Mobile nodes almost always hop to the next neighboring coverage

- b. Mobile IPv6 deployment architecture complexity, where Mobile IPv6 protocol proposes the use of a Home Agent as an external entity which adds larger inter packet delays, thus increasing the complexity of the network and incur higher cost of deployment
- c. Layer-2 triggers for mobile nodes which are currently based only on signal strength.

Therefore, it appears that there is a need for a new Mobile IPv6 protocol which will enables faster and smoother handovers.

Summary of Invention

The primary object of the present invention is to provide a method to speed Mobile IPv6 handovers between interconnected terminals by means of

- a. A faster and more efficient handoff algorithm to reside over wireless communications terminals
- b. A hybrid solution so that there is compatibility for both macro and micro mobility
- c. Build the Home Agent as a service on each terminals to reduce the network traversal time
- d. A more efficient Layer-2 trigger to initiate network movement

Description of Drawings

- Figure 1 Typical Mobile IPv6 scenario in wireless communication
- Figure 2 Message flow diagram of wireless communication Mobile IPv6
- Figure 3 Modified neighbor advertisement message
- Figure 4 Modified router advertisement message
- Figure 5 Exemplary scenario
- Figure 6 Message flow diagram

Figure 7 Flow chart of protocol

Detailed Description

The flow chart in Figure 7 gives a general view of the present invention which will be discussed in detail now. In the following description, detailed description of the known functions and configurations have been omitted for clarity and conciseness.

In the present invention the wireless communications terminals are defined as wireless communication terminal having WiFi front end and WiMax Back end or WiFi front end and HSDPA or Ethernet backend .

The method of speed Mobile IPv6 handovers between interconnected wireless communications terminals proposed by the present invention is implemented by the following phases:

Bootstrap Phase

In this phase each wireless communications terminal informs its neighboring wireless communications terminal of its presence by means of a modified neighborhood advertisement message as illustrated in Figure 3. The advertisement message contains a wireless communication flag set and also an advertisement lifetime, CPEs Media Access Control (MAC) address, built in WiFi modules' MAC address, WiFi Modules' IPv6 address and WiFi modules' ESSID in the option field. This message will be re-advertised compulsorily by the wireless communications terminal at the expiration of the advertisement lifetime or if there has been any changes in the addresses.

Information Building Phase

In this phase each terminal will be equipped with a wireless communications terminal table, which is dynamically updateable and contains the information of the neighboring terminals

Information dissemination phase

This phase contains the following sequence:

- i. A Mobile Node sends out a router solicitation message requesting for an IPv6 prefix, each time it connects to a terminal
- ii. The terminal responds with a modified router advertisement shown in Figure 4.
- iii. The Mobile Node then generates a its own wireless communications terminal Table and IPv6 address from the information found in the modified router advertisement
- iv. The router advertisement message subsequent to the first modified router advertisement message need not contain the full wireless communications terminal table because it only needs to reflect the changes made to the wireless communications terminal table.

Movement phase

In this phase a Mobile Node volunteers to move to the next terminal when it detects

- i. a weak signal from the current terminal; or
- ii. an increasing rate of frame errors during transmission; or
- iii. a reduced bandwidth and a second signal from a neighboring terminal

Prior to moving the Mobile Node configures it future IPv6 address from the information present in the wireless communications terminal table. It uses this address to send a Binding Update to its Home Agent.

The Mobile Node then proceeds to detach itself from the present terminal and attach itself to the new terminal. The Home Agent then assumes that the Mobile Node has moved and forwards the binding update and data packets to the new location of the Mobile Node.

Buffering Phase

In this phase each terminal stores the forwarded packets received from the Home Agent within the fixed sized buffer it is equipped with.

Re-attaching phase

In this phase the Mobile Node that has detached itself from its previous terminal in the Movement Phase, attaches itself to the new network and sends out a neighbor advertisement to announce its connection to the new network. At this point the terminal stops buffering and forwards the buffered packets to the Mobile Packet.

Backward Compatibility

This phase only occurs when the Mobile Node does not have any information of the new terminal in its wireless communications terminal table. In this instance the Mobile then abandons the fast handoff procedure and returns to the standard Mobile IPv6 procedure. This phase can also be utilized in hybrid scenario where intra-site movements use fast handover procedure while inter-site movements will use the standard Mobile IPv6

An example of the present invention can be seen in figure 5. From the figure it becomes clear that step no.5 i.e. the mobile node decides to move and sends a binding update, forms the most important part of the invention. This step illustrates the 'make before break' strategy employed by this invention. By means of this strategy the handover delay can be significantly reduced because the new terminal is prepared to accept the Mobile Node even before the connection between the Mobile Node and the prior terminal is broken. The only delay that can be observed is the Layer-2 attachment delay which is about 50-200 ms.

Claims

1. A method to allow a more prompt handover in Mobile IPv6 in a network by means of a mobile unit determining the future terminal that the mobile unit is to attach itself before detaching itself from its current terminal comprising the steps of:
 - determining the future terminal address of the mobile unit from the wireless communications terminal table and sending a binding update to the mobile unit's Home Agent
 - detaching the mobile unit from the mobile unit's present terminal and attaching the mobile unit to a new terminal
 - forwarding the binding updates and data packets from the Home Agent to the new terminal
 - storing packets received from Home Agent within the terminal's fixed sized buffer
 - sending out neighbor advertisement to announce the mobile unit's new location
 - forwarding the buffered packets to mobile unit upon receiving the terminal's neighbor advertisement.
2. A method according to claim 1, wherein the mobile unit will prepare to detach itself from its current terminal when there is a weak signal from the current terminal, an increasing rate in frame errors during transmission or a reduced bandwidth and a second signal is received from a neighboring terminal.
3. A method according to claim 1, where each terminal contains a wireless communications terminal table which consists of information of neighboring terminals.
4. A method according to claim 1, wherein each mobile node contains a wireless communications terminal table.

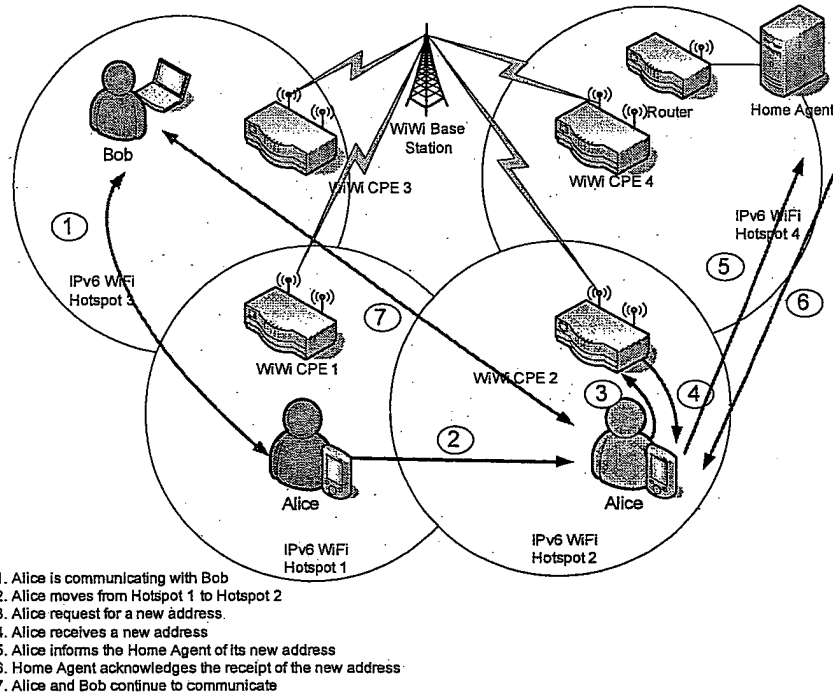


Figure 1

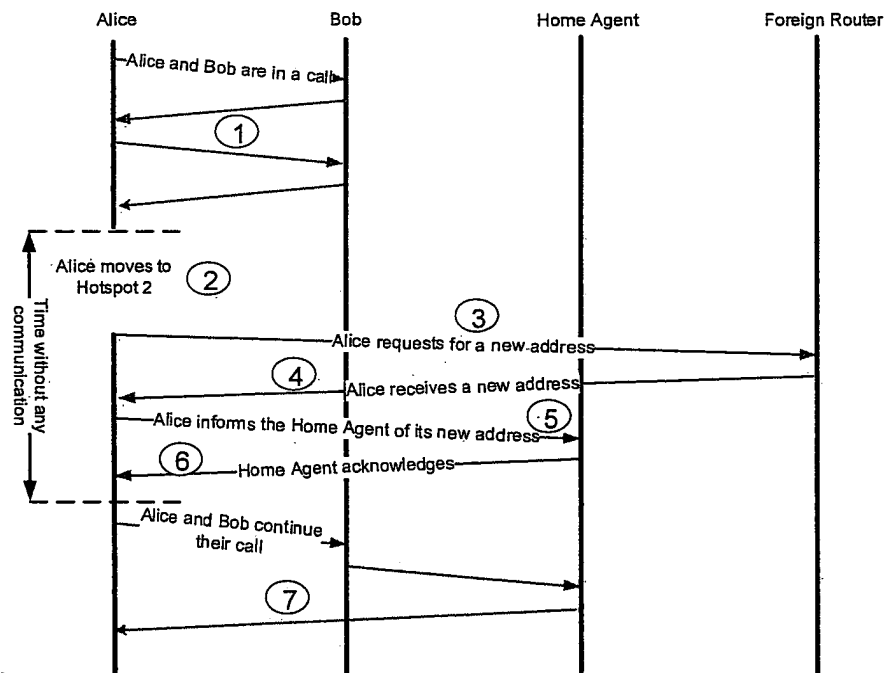


Figure 2

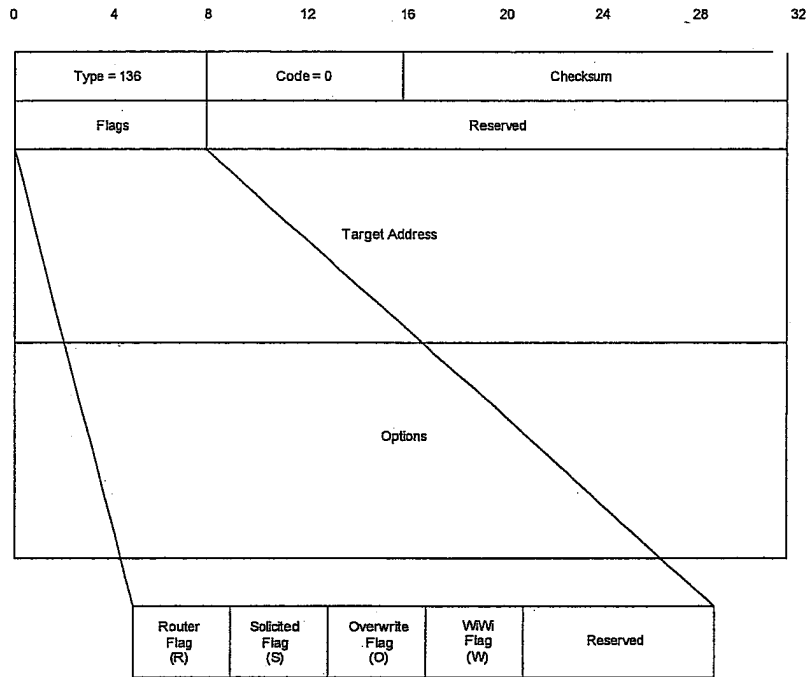


Figure 3

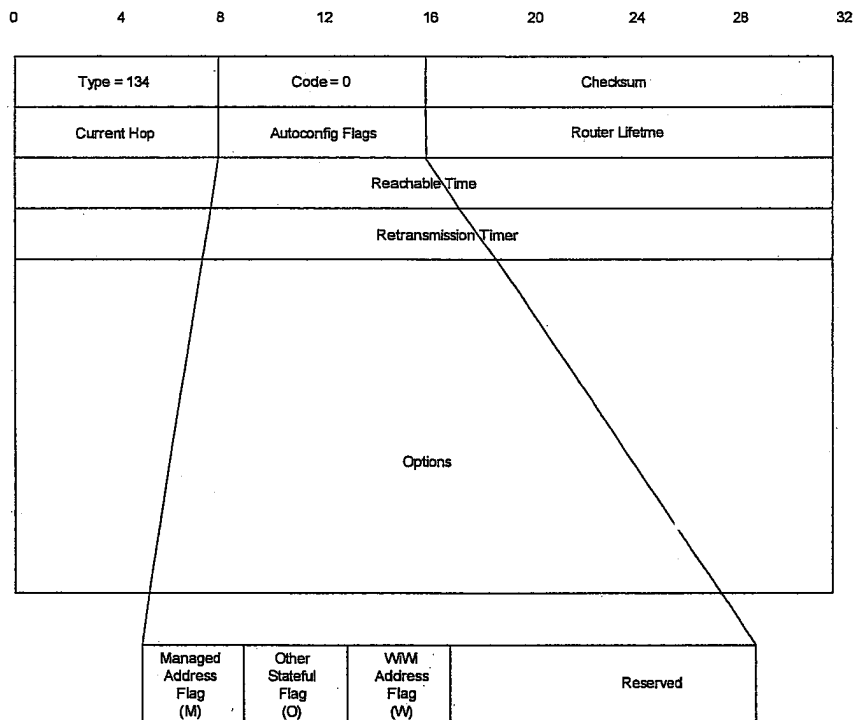
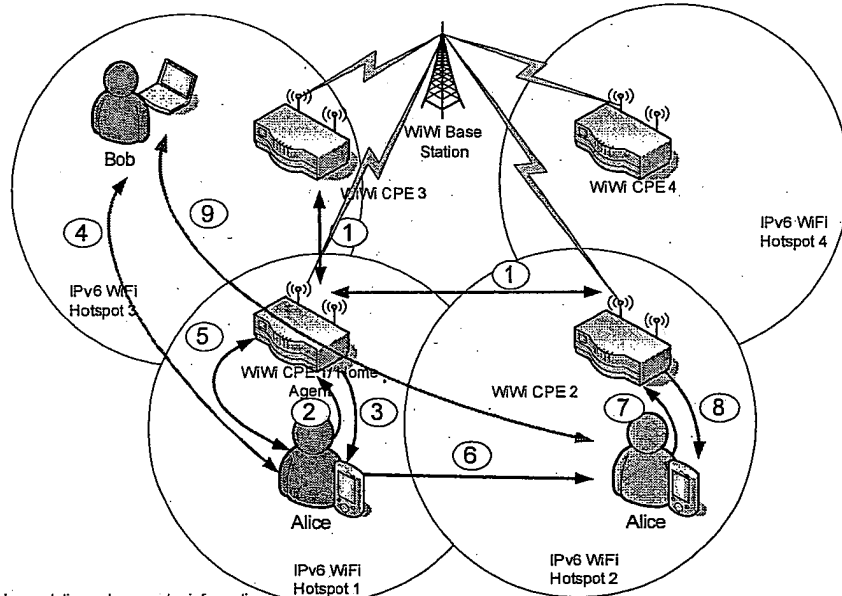


Figure 4



1. WiWi base stations share router information
2. Alice come online and requests an address
3. Alice gets the neighboring router information
4. Alice generates an address and communicates with bob
5. Alice decides to move and sends out binding update
6. Alice moves to a new network
7. Alice sends out a neighbor advertisement informing its attachment
8. CPE 2 forwards the buffered packets & binding acknowledgement
9. Alice and Bob continue to communicate

Figure 5

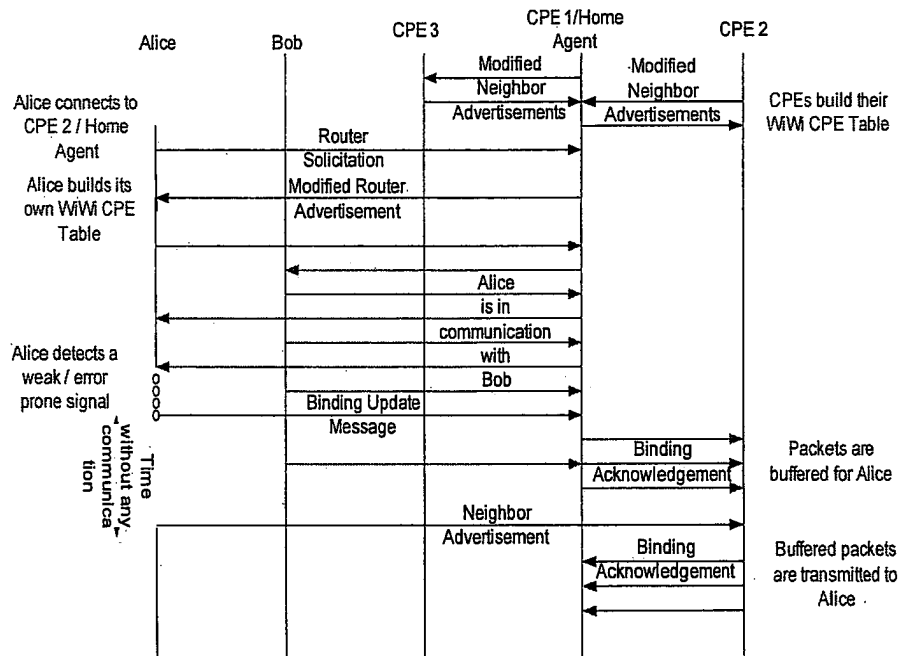


Figure 6

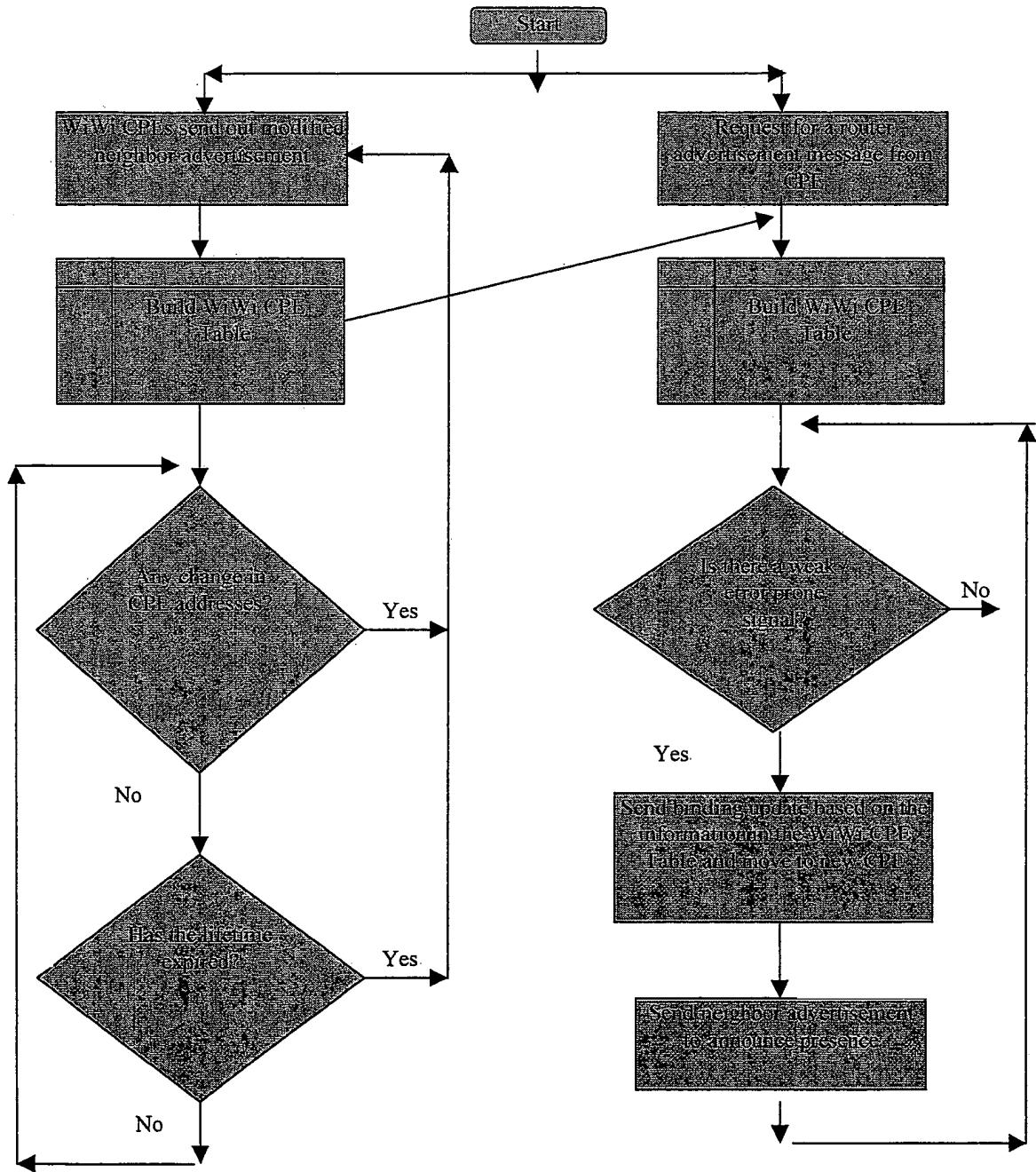


Figure 7

A. CLASSIFICATION OF SUBJECT MATTER***H04W 36/08(2009.01)i, H04W 8/12(2009.01)i***

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 9: H04W, H04Q, H04L, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility Models
Japanese Utility models and applications for Utility Models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & keywords: "mobile, IPv6, fast handover, packet forward, store"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006-0029020 A1 (HEE-YOUNG JUNG et al.) 09 Feb. 2006	1,3-4
Y	See abstract, figures 2,4-6, paragraphs [0012], [0038]-[0039], [0047], [0051]-[0052], [0054], [0057]-[0060], and claims 1,5,9-10.	2
Y	US 2005-0047372 A1 (MASASHI YANO et al.) 03 Mar. 2005 See abstract, figures 1,11, paragraphs [0044], [0053]-[0055], [0072]-[0074], and claims 1-3,6.	2
A	US 2007-0109997 A1 (YONG-GEUN HONG et al.) 17 May 2007 See abstract, figures 2-3, paragraphs [0019]-[0026], [0052]-[0057], and claims 1-4.	1-4
A	KR 10-0760957 B1 (KYUNGPOOK NATIONAL UNIVERSITY INDUSTRY-ACADEMIC COOPERATION FOUNDATION) 17 Sep. 2007 See abstract, figures 3,6, pages 8-10, and claims 1-5.	1-4

 Further documents are listed in the continuation of Box C. See patent family annex.

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Date of the actual completion of the international search

02 FEBRUARY 2010 (02.02.2010)

Date of mailing of the international search report

02 FEBRUARY 2010 (02.02.2010)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/MY2009/000139

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006-0029020 A1	09.02.2006	KR 10-0594819 B1 KR 10-2006-0012386 A US 7630340 B2	03.07.2006 08.02.2006 08.12.2009
US 2005-0047372 A1	03.03.2005	CN 1568044 A JP 2005-027314 A	19.01.2005 27.01.2005
US 2007-0109997 A1	17.05.2007	JP 2007-512758 A KR 10-2005-0050518 A KR 10-0594950 B1 WO 2005-053187 A1	17.05.2007 31.05.2005 30.06.2006 09.06.2005
KR 10-0760957 B1	17.09.2007	None	