(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 June 2007 (14.06.2007)

PCT

(10) International Publication Number
WO 2007/066866 A1

(51) International Patent Classification:
H04L 12/28 (2006.01)

(21) International Application Number:
PCT/KR2006/002488

(22) International Filing Date: 27 June 2006 (27.06.2006)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
10-2005-0118387
6 December 2005 (06.12.2005) KR

(71) Applicants *(for all designated States except US)*: **KT CORPORATION** [KR/KR]; 206, Jungja-dong, Bundang-gu, Seongnam-city, Kyeonggi-do 463-711 (KR). **SEOUL NATIONAL UNIVERSITY INDUSTRY FOUNDATION** [KR/KR]; San 4-2, Bongcheon-dong, Gwanak-gu, Seoul 151-050 (KR).

(72) Inventors; and

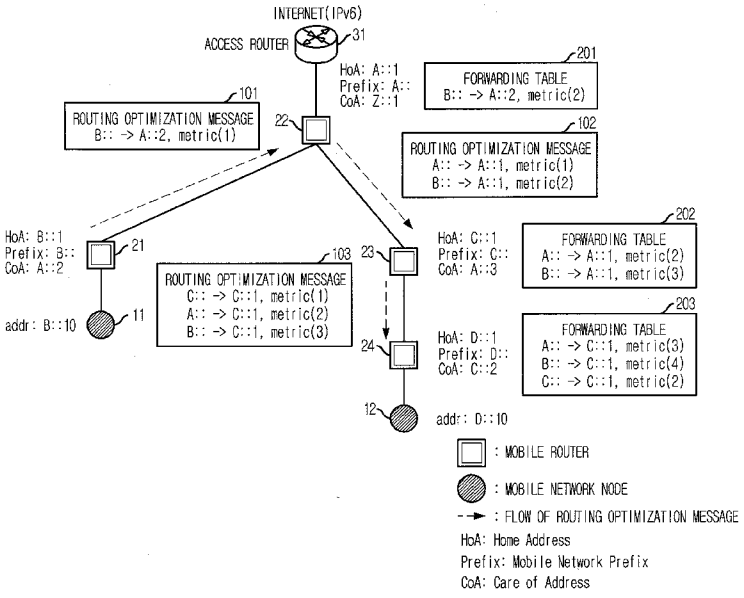
(75) Inventors/Applicants *(for US only)*: **PAIK, Eun-Kyoung** [KR/KR]; #412-1302 Sandeul maeul Hyundai Apt., Millak-dong, Uijeongbu-si, Gyeonggi-do 480-090 (KR). **NAM, Min-Ji** [KR/KR]; 1534-9, Sillim 9-dong, Gwanak-gu, Seoul 151-019 (KR). **PARK, Se-Jun** [KR/KR]; #101-1004 Hanbit Apt., Eoeun-dong, Yuseong-gu, Daejon 305-755 (KR). **CHOI, Yang-Hee** [KR/KR]; Seoul National Univ. Engineering, College, Sillim 9-dong, Gwanak-gu, Seoul 151-744 (KR). **KWON, Tae-Kyoung** [KR/KR]; Seoul National Univ. Engineering, College, Sillim 9-dong, Gwanak-gu, Seoul 151-744 (KR). **BAEK, Sung-Min** [KR/KR]; Seoul National Univ. Engineering, College, Sillim 9-dong, Gwanak-gu, Seoul 151-744 (KR). **CHO, Ho-Sik** [KR/KR]; Seoul National Univ. Engineering, College, Sillim 9-dong, Gwanak-gu, Seoul 151-744 (KR). **YOO, Jin-Gyu** [KR/KR]; Seoul National Univ. Engineering, College, Sillim 9-dong, Gwanak-gu, Seoul 151-744 (KR).

(74) Agent: **SHINSUNG PATENT FIRM**; 2-3F, Line Bldg., 823-30, Yeoksam-dong, Kangnam-ku, Seoul 135-080 (KR).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

[Continued on next page]

(54) Title: ROUTING OPTIMIZATION METHOD



(57) **Abstract:** Provided is a routing optimization method on a nested mobile network and a computer-readable recording medium recording a program using the same. The method includes the steps of : a) interactively transmitting a routing optimization message including a network prefix of an internal interface at each mobile router on the nested mobile network; b) creating/updating a forwarding table based on the transmitted routing optimization message; and c) when a mobile router (MR) transmits a received packet, comparing a destination Internet Protocol (IP) address of the packet with an entry of the forwarding table and forwarding the packet to a corresponding interface based on information of the forwarding table.

WO 2007/066866 A1

(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, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

ROUTING OPTIMIZATION METHOD

Description

Technical Field

The present invention relates to a routing optimization method on a nested mobile network and a computer-readable recording medium recording a program using the same; and, more particularly, to a routing optimization method on a nested mobile network that each user terminal can fast and efficiently communicate through routing optimization of a packet when user terminals within nested network mobility (Intra-NEMO) communicate under nested network mobility protocol obtained by extending a NEMO basic support protocol developed to support mobility of the Internet, and a computer-readable recording medium recording a program using the same.

Background Art

Terms used in the present invention will be defined as follows.

Home address (HoA) is an address used to identify each mobile node (MN) in mobile Internet protocol (IP).

Care of address (CoA) is an address having location information of the mobile node in the mobile IP.

Prefix is a mobile network prefix.

A network mobility support protocol, a home agent (HA) and mobile router (MR) should be basically set up to support ceaseless communication in a mobile user terminal. Also, protocol is required to be extended for efficient communication between user terminals under a nested mobile network. Accordingly, in the present invention, the user terminals under the nested mobile network define a series of protocols to interactively communicate

through an optimal route.

The currently used Internet is invented to be used in a fixed public place by applying Transmission Control Protocol/Internet Protocol (TCP/IP).

However, as a mobile technology is developed day by day, Internet users desire to receive the same service not only they are in the fixed place but also on the move. Accordingly, Internet Engineering Task Force (IETF) forms a working group for a mobile IP and tries to establish the mobile IP standard. As a result, the mobile IP standard in IPv4 and IPv6 is actually confirmed.

The mobile IP is well operated when an individual user terminal moves, but has many problems when a subnet including a plurality of user terminals simultaneously operate. That is, when a portable Internet device is used, it is expected that users desire to wirelessly access to the Internet while moving through transportation such as a bus, subway, and a car. Accordingly, when each user communicates based on the mobile IP, there is a problem that all users should register location information in case that transportation such as the subway loading many users moves from one cell to another.

Therefore, discussion on network mobility (NEMO) supporting the movement of a subnet unit based on the mobile IP of an IPv6 version has been progressed. As a result, a working group is formed in the IETF and a related standard has been established. However, a research on routing optimization for efficient communication between user terminals in the inside of the nested mobile network has been progressed, but a related standard is not established yet.

The NEMO basic support protocol suggested by the IETF introduces a concept of a router capable of moving called a mobile router (MR) and sets up the mobile router

in transportation. When the transportation is moving, the NEMO basic support protocol considers that an entire network moves and only the mobile router updates location information in a corresponding home agent.

However, according to the NEMO basic support protocol, two user terminals included in the nested mobile network can communicate only through the home agent of the mobile routers having a structure nested to the home agent of each user terminal. Herein, the home agent of the mobile router having the structure nested to the home agent of each user terminal is located in the outside of the nested mobile network and it causes long delay in communication. In particular, when the user terminal or the mobile router is far away from its own home link, the delay becomes a serious problem. Therefore, when terminals included in the same nested mobile network communicate, an efficient routing method should be found.

Disclosure

Technical Problem

It is, therefore, an object of the present invention to provide a routing optimization method on a nested mobile network that each user terminal can fast and efficiently communicate through routing optimization of a packet when user terminals communicate within nested network mobility (NEMO), i.e., Intra-NEMO, under nested network mobility protocol, and a computer-readable recording medium a recording a program using the same.

Other objects and advantages of the invention will be understood by the following description and become more apparent from the embodiments in accordance with the present invention, which are set forth hereinafter. It will be also apparent that objects and advantages of the

invention can be embodied easily by the means defined in claims and combinations thereof.

Technical Solution

In accordance with one aspect of the present invention, there is provided a communication routing optimization method on a nested mobile network, including the steps of: a) interactively transmitting a routing optimization message including a network prefix of an internal interface at each mobile router on the nested mobile network; b) creating/updating a forwarding table at each mobile router on the nested mobile network based on the transmitted routing optimization message; and c) when a mobile router (MR) transmits a received packet, comparing a destination Internet Protocol (IP) address of the packet with an entry of the forwarding table and forwarding the packet to a corresponding interface based on information of the forwarding table.

The communication routing optimization method further includes the step of: d) when a mobile router transmits a received packet, comparing a destination IP address of the packet with an entry of the forwarding table and transmitting the packet through a bi-directional tunnel to a home agent (HA).

In accordance with another aspect of the present invention, there is provided a computer-readable recording medium for storing a routing optimization program in mobile network system having a processor for communication in a nested mobile network, including the steps of: a) interactively transmitting a routing optimization message including a network prefix of its own internal interface by each mobile router on the nested mobile network; b) creating/updating a forwarding table based on the transmitted routing optimization

message; and c) when a mobile router transmits the received packet, comparing a destination Internet Protocol address of a corresponding packet with an entry of the forwarding table and forwarding the corresponding packet to a corresponding interface based on information of the forwarding table.

Also, the present invention provides a computer-readable recording medium recording a program, which includes the steps of: a) comparing the destination IP address of the corresponding packet with the entry of the forwarding table when one mobile router transmits the transmitted packet, and b) when there is no entry, transmitting the packet through a bi-directional tunnel to the home agent.

The present invention suggests a communication routing optimization method for efficient communication between user terminals under the nested mobile network.

For communication routing optimization, the mobile router and the user terminal applies exchange of the message and the routing table. It is an additional thing which is not required to use and Internet or a NEMO basic support protocol in the conventional fixed environment. Accordingly, the message exchange and the size of the routing table should be minimized. It is an essential element for searching an optimal communication route by exchanging a message fast.

Therefore, the present invention focuses on setting up an optimal route when each user terminal communicates on the nested mobile network and minimizing an additional cost. Also, the present invention suggests a distributed structure to acquire security.

Advantageous Effects

In communication between mobile network nodes on a

nested mobile network, the present invention can transmit a packet through an optimal network route without going through a mobile router having a nested structure and a home agent of each mobile router.

In the present invention, communication between visiting mobile nodes (VMNs) visiting an external network or between the visiting mobile node and the local fixed node as well as communication between local fixed nodes (LFNs) can be performed through an optimal route.

Also, the present invention considers routing optimization between mobile nodes in case that the mobile nodes following a Mobile IPv6 protocol are located on the nested mobile network. Accordingly, when the routing optimization technique suggested in the Mobile IPv6 protocol is adopted, the optimal route can be secured, just as the local fixed node does.

Also, the mobile network is a protocol structure considering mobility. When an entire mobile network changes a location on a network, the mobile network nodes on the mobile network do not recognize the change of the location and do not generate a signal for newly updating its own location information. The characteristic is called transparency on mobility and becomes a representative merit of the mobile network protocol. Therefore, when the entire nested mobile network moves, the present invention can secure transparency on mobility. That is, the present invention secures an optimal route, but does not simultaneously generate a signal due to update of additional location information due to the network mobility.

According to the present invention, when the mobile network protocol is applied to Internet access and a personal portable terminal, it is possible to provide a call or a service of a good quality to clients in a call between the clients within a specific region, an

interactively working application, traffic control between each vehicles and a scenario of a traffic control system for other application. Also, a service provider can more efficiently use network resources.

Description of Drawings

The above and other objects and features of the present invention will become apparent from the following description of the preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig. 1 shows a procedure that routing optimization messages are transmitted in accordance with an embodiment of the present invention;

Fig. 2 shows a data packet transmitting method of an optimized route in accordance with the embodiment of the present invention;

Fig. 3 shows a routing optimization message in accordance with an embodiment of the present invention;

Fig. 4 shows a forwarding table entry format of the routing optimization message in accordance with the embodiment of the present invention; and

Fig. 5 shows a forwarding table data structure of a mobile router in accordance with the embodiment of the present invention.

Best Mode for the Invention

Other objects and advantages of the present invention will become apparent from the following description of the embodiments with reference to the accompanying drawings. Therefore, those skilled in the field of this art of the present invention can embody the technological concept and scope of the invention easily. In addition, if it is considered that detailed

description on a related art may obscure the points of the present invention, the detailed description will not be provided herein. The preferred embodiments of the present invention will be described in detail hereinafter with reference to the attached drawings.

The present invention suggests a method for setting up an optimal communication route when each user terminal communicates with other user terminal on the same nested mobile network under a nested network mobility support protocol for supporting that the nested mobile network including a plurality of mobile networks forms one unit.

As described above, when the user terminals in the inside of the nested mobile network interactively communicate, applying network mobility (NEMO) basic support protocol causes long delay. When the user terminals in the inside of the same nested mobile network interactively communicate, routing optimization is required.

In the present invention, each mobile router (MR) interactively transmits a routing message including a network prefix of its own internal interface and all mobile routers (MRs) create a forwarding table based on the transmitted routing message on the nested mobile network. Subsequently, before the mobile router transmits the received packet through a bi-directional tunnel with its own home agent (HA), the mobile router forwards the packet to a corresponding interface in case that a destination IP address of a corresponding packet is the same as an entry of a forwarding table based on information of the forwarding table. Otherwise, the mobile router transmits the packet through a bi-directional tunnel to the home agent, as a definition of the NEMO basic support protocol.

Since the present invention has a stateless distributed structure, which does not require status

information, an additional agent for routing optimization is not required. Also, user terminals included in the same nested mobile network can communicate through an optimal route, it is possible to minimize communication delay. Accordingly, a real time game, real time communication, a walky-talky service, and data transmission between user terminals in the inside of one mobile network such as the same vehicle or train can be efficiently performed.

A method for optimizing a communication route of the user terminals on one nested mobile network in a structure of the nested mobile network will be described hereinafter.

According to the brief description of the communication routing optimization method, each of mobile routers 21 to 24 interactively transmits a routing message including a network prefix of its own internal interface (see Fig. 1) and all mobile routers 21 to 24 on the nested mobile network create a forwarding table based on the transmitted routing message (see Fig. 1). Before the mobile routers 21 to 24 transmit the received packet through a bi-directional tunnel with its own home agent (see Fig. 2), the mobile routers 21 to 24 forward the packet to a corresponding interface based on the information of the forwarding table in case that the destination IP address of the corresponding packet is the same as the entry of the forwarding table. Otherwise, the mobile routers 21 to 24 transmit the packet through the bi-directional tunnel to the home agent, just as the definition of the NEMO basic support protocol.

A procedure for transmitting the routing optimization message is as follows.

The mobile router following the NEMO basic support protocol does not have information on a network prefix of an internal interface of other mobile routers or mobile

network nodes in a structure of the nested mobile network, The mobile router basically transmits all packets toward the home agent of the mobile router.

Meanwhile, in the present invention, all mobile routers 21 to 24 on the nested mobile network can figure out the information of the network prefix in the internal interface of other mobile routers 21 to 24 through the routing optimization message (see Fig. 3). Herein, a point of the contents included in the routing optimization message is that the packet can be transmitted to the destination included in the message within a few hops in case that the mobile routers transmit a corresponding packet to themselves.

That is, when its own forwarding table is vacant (see Fig. 5), the mobile routers 21 to 24 transmit a routing optimization message having contents that the mobile routers 21 to 24 can transmit a packet to an address region of its own internal interface, i.e., having one forwarding table entry (see Fig. 4), through its own all interface. When there are two forwarding table entries in its own forwarding table, the mobile routers 21 to 24 transmit the routing optimization message including the forwarding table entry on the address region of its own internal interface and two forwarding table entries in the conventional forwarding table through all interfaces.

Herein, the routing optimization message has all nodes of a corresponding interface, i.e., the mobile routers MR 21 to 24, receive the routing optimization message based on IPv6 link local multicast.

The routing optimization message basically transmitted to all interfaces including the forwarding table entry of all forwarding tables every specific cycle. When metric information of a specific entry of a forwarding table is updated, the routing optimization

message including only a forwarding table entry of updated contents is transmitted.

Subsequently, when the transmitted forwarding table entry does not exist in its own forwarding table, the mobile routers 21 to 24 receiving the routing optimization message adds a corresponding forwarding table entry to the forwarding table. However, when an entry having the same address region as the transmitted forwarding table entry exists in the forwarding table, the mobile routers 21 to 24 compare the metric of each forwarding table entry with the newly received forwarding table entry. When the newly received forwarding table entry is smaller than the metric of the conventional forwarding table entry, the newly received forwarding table entry is replaced with a new forwarding table entry. Otherwise, the newly received forwarding table entry is ignored.

A routing optimization message transmitting and forwarding table updating procedure will be described in detail with reference to Fig. 1.

Fig. 1 shows a procedure that routing optimization messages 101 to 103 are transmitted and each mobile router 21 to 24 create forwarding tables 201 to 203.

Since it is complicated to express information of all mobile routers 21 to 24, the routing optimization message transmitting and forwarding table updating procedure will be described in detail based on the mobile router 21 having B::1 as the home address (HoA).

The mobile router 21 of a home address B::1 can transmit a packet to a mobile network node (MN) 11 corresponding to a mobile network prefix B:: of its own internal interface through one hop. Accordingly, the mobile router 21 transmits the routing optimization message 101 to the mobile router 22, which is a home address A::1. An IP address of B::1, which is

identifiable in a corresponding interface, is A::2, i.e., the care of address (CoA). Therefore, a source address of a routing optimization message is A::2.

Since the mobile router 22 of the home address A::1 receives the new routing optimization message 101, the mobile router 22 adds corresponding information to a forwarding table 201. Herein, the metric value becomes 2 by adding the number of hops of the mobile router 22 and the B::1 mobile router 21. Since the A::1 mobile router 22 updates the forwarding table 201, the A::1 mobile router 22 transmits the routing optimization message 102 through all interfaces.

Since the mobile router 23 of a home address C::1 receives the new routing optimization message 102, the mobile router 23 adds corresponding information to a forwarding table 202. A metric value becomes 3 by adding the number of hops of the mobile router 23 and the A::1 mobile router 22. Since the C::1 mobile router 23 updates a forwarding table 202, the C::1 mobile router 23 transmits a routing optimization message 103 through all interfaces.

Since the mobile router 24 of a home address D::1 receives the new routing optimization message 103, the mobile router 24 adds corresponding information to a forwarding table 203. A metric value becomes 4 by adding the number of hops of the mobile router 24 and the C::1 mobile router 23.

As described above, next mobile routers 21 to 24 to transmit a packet are determined such that all mobile routers 21 to 24 of the nested mobile network can transmit a packet to the mobile network node 11 having a B:: prefix.

A procedure for transmitting a packet to an optimal route will be described in detail.

When the mobile routers 21 to 24 receive a packet

from the mobile network nodes 11 and 12, or other mobile routers 21 to 24, the mobile routers 21 to 24 searches in a forwarding table whether a forwarding table entry matching with a destination IP address of the corresponding packet exists.

When it turns out that the destination IP address of the corresponding packet matches with a specific entry of the forwarding table, the mobile routers 21 to 24 transmits a corresponding packet based on next hop information of the forwarding table.

When the forwarding table entry matching with the destination IP address of the corresponding packet does not exist, the packet is transmitted through a bi-directional tunnel to the home agent.

To be more specific, in Fig. 2, when the mobile network node 12 having an IP address D::10 transmits a data packet 301 to the mobile network node 11 having an IP address B::10, a start address is D::10 and a destination address is B::10.

The data packet 301 is transmitted to the mobile router 24 of the home address D::1. Through search of its own forwarding table 203, the D::1 mobile router 24 figures out that the D::1 mobile router 24 can transmit a packet having a prefix destination address of B:: to the mobile router 23 of the home address C::1 only within 4 hops. Therefore, the D::1 mobile router 24 transmits the corresponding packet 301 to the C::1 mobile router 23.

Subsequently, through search of its own forwarding table 202, the C::1 mobile router 23 figures out that the C::1 mobile router 23 can transmit a packet having the prefix destination address of B:: to the mobile router 22 of the home address A::1 only within 3 hops. Therefore, the C::1 mobile router 23 transmits the corresponding packet 301 to the A::1 mobile router 22.

Just as the same method, the corresponding packet

301 is transmitted to the mobile network node 11 through the mobile router 22 of the home address A::1 and the mobile router 21 of the home address B::1.

The routing optimization message will be described in detail with reference to Fig. 3.

A command of the routing optimization message is divided into Request, Response, and Default.

The Request is a command which does not wait a cycle that the routing optimization message is transmitted and requests a routing optimization message to a near mobile router for fast routing optimization when a new mobile router attends the nested mobile network.

As a response to the Request message, a routing optimization message to be transmitted to the mobile router request the routing optimization message is a Response message.

The routing optimization message, which is basically transmitted every specific cycle, has a Default command.

The routing optimization message includes a plurality of 20-bytes forwarding table entries.

As shown in Fig. 4, each of 20-bytes forwarding table entry includes a field for a 16-bite IPv6 prefix and has information on a 1-bite network prefix length and a 1-bite route metric.

Meanwhile, a structure of the forwarding table included in the mobile router is as shown in Fig. 5.

The forwarding table has IPv6 prefix, metric, next hop, and last time fields.

The IPv6 prefix field shows an IPv6 address region prefix of the destination address for routing optimization.

The metric field shows a network route metric consumed for transmission to a corresponding destination IP address.

The next hop field shows a next mobile router which

the mobile router should transmit in case that a packet is transmitted through routing optimization.

The last time field shows a recent transmission time of each forwarding table entry. Since the mobile router can leave the nested mobile network without transmitting an explicit message in the nested mobile network, the corresponding forwarding table entry should be deleted when a specific time passes. When the forwarding table entry is not updated for a predetermined time with reference to the last time field, the corresponding forwarding table entry should be deleted.

As described above, the technology of the present invention can be realized as a program and stored in a computer-readable recording medium, such as CD-ROM, RAM, ROM, floppy disk, hard disk and magneto-optical disk. Since the process can be easily implemented by those skilled in the art, further description will not be provided herein.

While the present invention has been described with respect to certain preferred embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

What is claimed is:

1. A communication routing optimization method on a nested mobile network, comprising the steps of:

a) interactively transmitting a routing optimization message including a network prefix of an internal interface at each mobile router on the nested mobile network;

b) creating/updating a forwarding table at each mobile router on the nested mobile network based on the transmitted routing optimization message; and

c) when a mobile router (MR) transmits a received packet, comparing a destination Internet Protocol (IP) address of the packet with an entry of the forwarding table and forwarding the packet to a corresponding interface based on information of the forwarding table.

2. The method as recited in claim 1, further comprising the step of:

d) when a mobile router transmits a received packet, comparing a destination IP address of the packet with an entry of the forwarding table and transmitting the packet through a bi-directional tunnel to a home agent (HA).

3. The method as recited in claim 1, wherein the routing optimization message includes information informing the number of hops that the received packet passes to be transmitted to a destination included in the message.

4. The method as recited in claim 3, wherein the routing optimization message is transmitted to all nodes of a corresponding interface, i.e., mobile routers, based on an IPv6 link local multicast.

5. The method as recited in claim 4, wherein in transmission of the routing optimization message, when the forwarding table of the mobile router is vacant, the mobile router transmits a routing optimization message having contents that the mobile router can transmit a packet to an address region of the internal interface, i.e., having only one forwarding entry, through all interface of the mobile router, and when a forwarding table entry exists in the forwarding table, the mobile router transmits a routing optimization message including the forwarding table entry on the address region of the internal interface and the forwarding entry in an existing forwarding table through all interfaces.

6. The method as recited in claim 5, wherein in reception of the routing optimization message, when the transmitted forwarding table entry does not exist in the forwarding table of the mobile router, the mobile router adds the corresponding forwarding table entry to the forwarding table, and when an entry of the same address region as the transmitted forwarding table entry exists in the forwarding table, the mobile router compares metrics of forwarding table entries and replaces the forwarding table entry with a new forwarding table entry in case that the newly received forwarding table entry has a smaller metric than the existing forwarding table entry, or ignores the newly received forwarding table entry in case that the newly received forwarding table entry does not have a smaller metric than the existing forwarding table entry.

7. The method as recited in claim 6, wherein when a packet is transmitted from a mobile network node or another mobile router, the mobile router searches a forwarding table entry matching with a destination IP

address of a corresponding packet in the forwarding table and transmits the packet based on next hop information of the forwarding table in case that the forwarding table entry matches with the destination IP address of the packet or transmits the corresponding packet through a bi-directional tunnel to the home agent table in case that the forwarding table entry does not match with the destination IP address of the corresponding packet.

8. The method as recited in claim 4, wherein the routing optimization message includes at least one forwarding table entry and each forwarding table entry includes IPv6 prefix information, network prefix length information, and route metric information.

9. The method as recited in claim 8, wherein the forwarding table has IPv6 address region prefix information of a destination address for routing optimization, metric information of a network route used for transmission to a corresponding destination IP address, next mobile router information that the mobile router should transmit when a packet is transmitted through routing optimization, and recent transmission time information of each forwarding table entry.

10. The method as recited in claim 9, wherein when the forwarding table entry is not updated for a predetermined time based on the recent transmission time information, the mobile router deletes the forwarding table entry.

11. A computer-readable recording medium for storing a routing optimization program in mobile network system having a processor for communication in a nested mobile network, comprising the steps of:

a) interactively transmitting a routing optimization message including a network prefix of its own internal interface by each mobile router on the nested mobile network;

b) creating/updating a forwarding table based on the transmitted routing optimization message; and

c) when a mobile router (MR) transmits the received packet, comparing a destination Internet Protocol (IP) address of a corresponding packet with an entry of the forwarding table and forwarding the corresponding packet to a corresponding interface based on information of the forwarding table.

12. The computer-readable recording medium as recited in claim 11, further comprising the step of:

d) when a mobile router transmits the received packet, comparing a destination IP address of the packet with an entry of the forwarding table and transmitting the packet through a bi-directional tunnel to a home agent (HA).

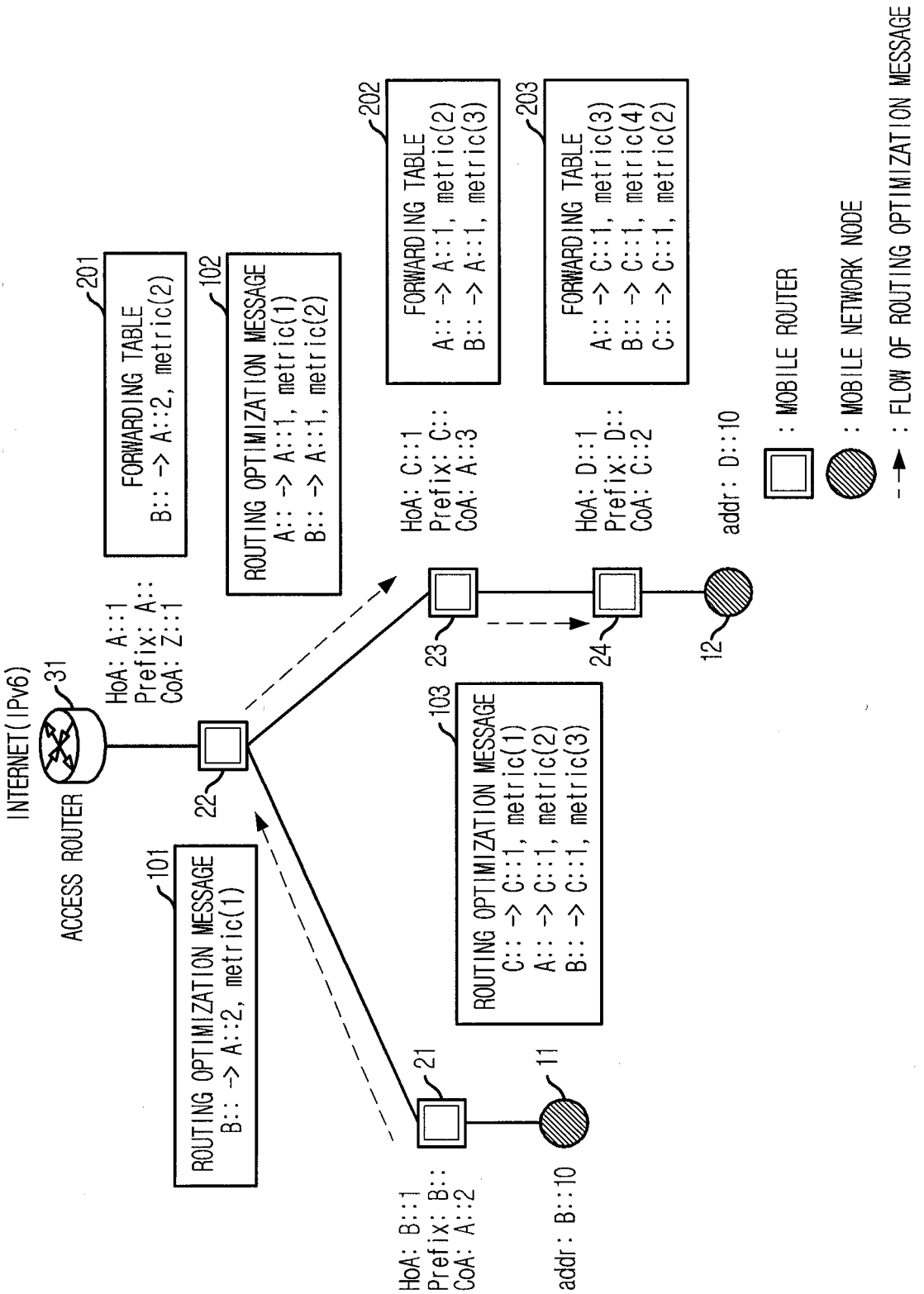

INTERNET(IPv6)
ACCESS ROUTER
31
HoA: A::1
Prefix: A::
CoA: Z::1
201
FORWARDING TABLE
B:: -> A::2, metric(2)
102
ROUTING OPTIMIZATION MESSAGE
A:: -> A::1, metric(1)
B:: -> A::1, metric(2)
101
ROUTING OPTIMIZATION MESSAGE
B:: -> A::2, metric(1)
22
103
ROUTING OPTIMIZATION MESSAGE
C:: -> C::1, metric(1)
A:: -> C::1, metric(2)
B:: -> C::1, metric(3)
21
HoA: B::1
Prefix: B::
CoA: A::2
11
addr: B::10
23
HoA: C::1
Prefix: C::
CoA: A::3
202
FORWARDING TABLE
A:: -> A::1, metric(2)
B:: -> A::1, metric(3)
24
HoA: D::1
Prefix: D::
CoA: C::2
203
FORWARDING TABLE
A:: -> C::1, metric(3)
B:: -> C::1, metric(4)
C:: -> C::1, metric(2)
12
addr: D::10
: MOBILE ROUTER
: MOBILE NETWORK NODE
: FLOW OF ROUTING OPTIMIZATION MESSAGE
HoA: Home Address
Prefix: Mobile Network Prefix
CoA: Care of Address

FIG. 1

FIG. 2

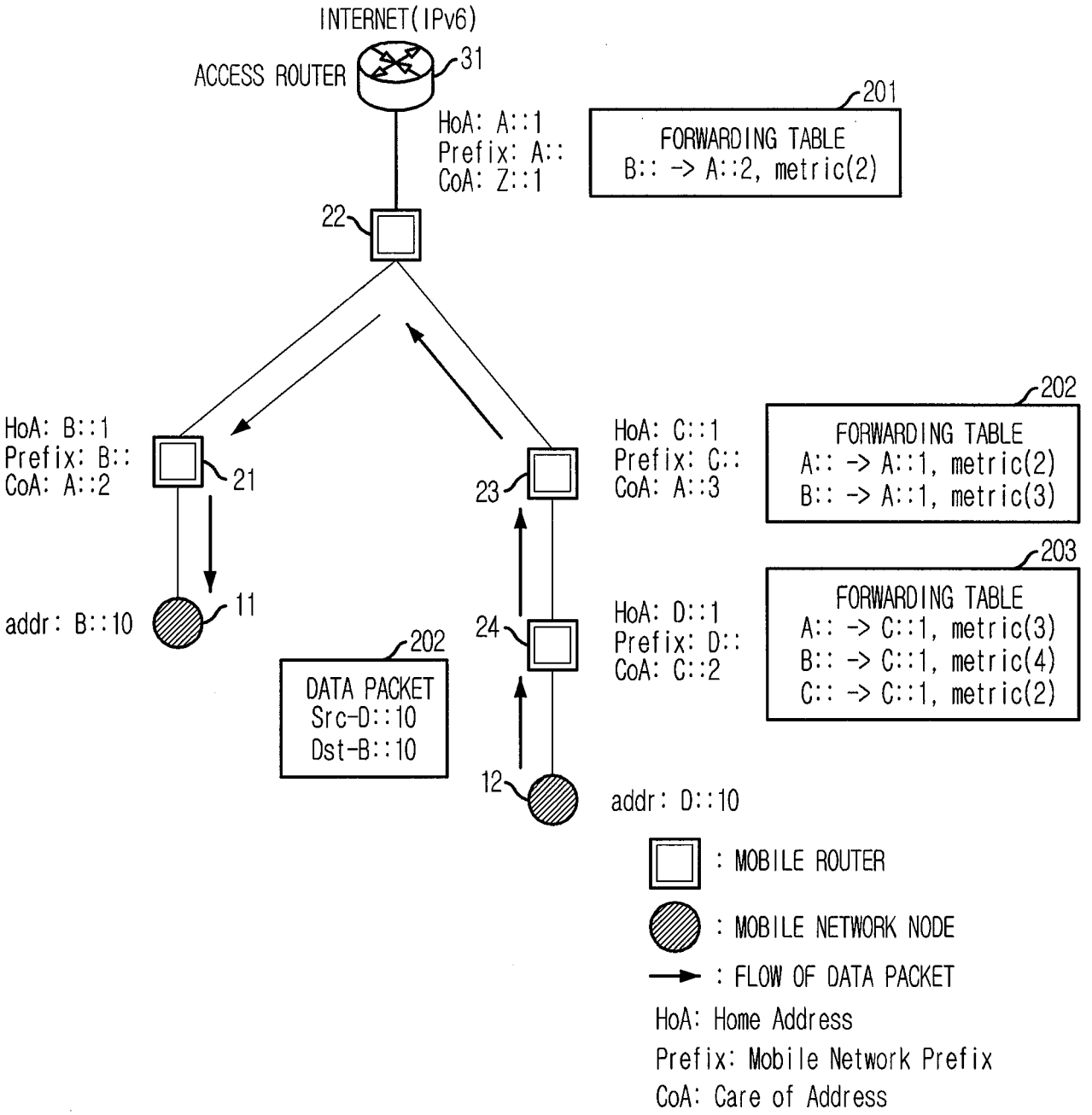

INTERNET(IPv6)
ACCESS ROUTER
31
HoA: A::1
Prefix: A::
CoA: Z::1
201
FORWARDING TABLE
B:: -> A::2, metric(2)
22
HoA: B::1
Prefix: B::
CoA: A::2
21
addr: B::10
11
23
HoA: C::1
Prefix: C::
CoA: A::3
202
FORWARDING TABLE
A:: -> A::1, metric(2)
B:: -> A::1, metric(3)
203
FORWARDING TABLE
A:: -> C::1, metric(3)
B:: -> C::1, metric(4)
C:: -> C::1, metric(2)
24
HoA: D::1
Prefix: D::
CoA: C::2
202
DATA PACKET
Src-D::10
Dst-B::10
12
addr: D::10
: MOBILE ROUTER
: MOBILE NETWORK NODE
: FLOW OF DATA PACKET
HoA: Home Address
Prefix: Mobile Network Prefix
CoA: Care of Address

FIG. 3

command(1)	reserved(3)
forwarding table entry 1(20)	
...	
forwarding table entry N(20)	

UNIT(N): BYTE

FIG. 4

IPv6 prefix(16)		
prefix len(1)	metric(1)	reserved(2)

UNIT(N): BYTE

FIG. 5

IPv6 prefix	metric	next hop	last time
. . .	. . .	. . .	. . .

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2006/002488

A. CLASSIFICATION OF SUBJECT MATTER

H04L 12/28(2006.01)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)

IPC8: G06F, H04L

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

Korean Patents and applications for inventions since 1975
Korean Utility models and applications for Utility models since 1975
Japanese Utility models and application for Utility models since 1975

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

EKIPASS (KIPO internal), IEEE xplore

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	'R-BU: recursive binding update for route optimization in nested mobile networks', Hosik Cho; Eun Kyoung Paik; Yanghee Choi; Vehicular Technology Conference, 2003. VTC 2003-Fall. 2003 IEEE 58th, Volume 3, 6-9 Oct. 2003 Page(s): 2063 - 2067	1 - 12
A	'Route optimization for mobile nodes in mobile network based on prefix delegation',KyeongJin Lee; Jungsoo Park; Hyoungjun Kim; Vehicular Technology Conference, 2003. VTC 2003-Fall. 2003 IEEE 58th, Volume 3, 6-9 Oct. 2003 Page(s): 2035 - 2038	1- 12
A	'OptiNets: an architecture to enable optimal routing for network mobility', Perera, E.; Seneviratne, A.; Sivaraman, V.; Wireless Ad-Hoc Networks, 2004 International Workshop on 31 May-3 June 2004 Page(s):68 - 72	1 - 12

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 OCTOBER 2006 (19.10.2006)	**19 OCTOBER 2006 (19.10.2006)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701,
Republic of Korea
Facsimile No. 82-42-472-7140

Authorized officer
JUN, Young Sang
Telephone No. 82-42-481-5653

Form PCT/ISA/210 (second sheet) (April 2005)