Proposal and Implementation of a New Method of Selecting the Optimal Relay Server Using NTMobile

Yuka Miyake
Graduate School of Science and Technology, Meijo University,
Aichi 468-8502, Japan
Email: yuka.miyake@wata-lab.meijo-u.ac.jp

Hidekazu Suzuki
Graduate School of Science and Technology, Meijo University,
Aichi 468-8502, Japan
Email: hsuzuki@meijo-u.ac.jp

Katsuhiro Naito
Information Science,
Aichi Institute of Technology,
Aichi 470-0392, Japan
Email: naito@pluslab.org

Akira Watanabe
Graduate School of Science and Technology, Meijo University,
Aichi 468-8502, Japan
Email: wtnbakr@meijo-u.ac.jp

I. Introduction

With the development and spread of wireless communication technologies, the demand for the use of networks is rapidly increasing. Along with this trend, there is an increasing demand for both connectivity and mobility.

"NTMobile"(Network Traversal with Mobility) is our original, next generation technology that realizes connectivity and mobility simultaneously[1], [2], [3]. In the case of NTMobile, the communication route does not become redundant, because communication is basically conducted between nodes directly. But, in the environment where no direct communication is feasible, the system needs to go through an RS (Relay Server), which plays the role of relaying packets. We propose in this Paper a method of minimizing the communication route by selecting the optimal RS based on the number of hops of the route. We implemented a proto-type system based on our proposed method, and we will report in this Paper the results of the verification of behaviors and evaluation of performance we conducted.

II. NTMobile

NTMobile is composed of "NTM nodes" with NTMobile function implemented, packet relay devices "RS", and a "DC"(Direction Coordinator) administering address information of NTM nodes and RSs. The DC and RSs can exist dispersedly in the global network. RSs are independent relay devices and thus, the optimal RS can be chosen for each communication.

In NTMobile, communication is basically conducted between NTM nodes directly, but in the case where direct communication is not possible, communication is conducted through an RS. As examples of non-availability of direct communication, we can name such cases as communication between NTM nodes under different NATs, communication between an NTM node and a General Server (GS) with no NTMobile implemented, and communication in the IPv4/IPv6 co-existing environment.

Because RS is a mere communication relay device, it is possible to switch RSs during communication in the case where it is conducted between NTM nodes. However, in the case of communication between an NTM node and a GS, it is not possible to switch RSs during communication since the GS recognizes the RS as its corresponding node.

For communication through an RS, if an appropriate RS is not chosen, there is a possibility that the route between the NTM node and its corresponding node gets redundant.

III. Proposed Method

A. Survey of the number of hops in the case of communication between NTM nodes

Fig. 1 shows the sequence of a survey of the hop count between an NTM node and RSs. The NTM node makes registration processing of address information against DC at its own activation or after the switching of networks. The DC, after registering address information in its database, sends to the NTM node an NTM Survey Direction with a description of such information as the IP addresses of the RSs subject to the survey and instructs it to survey the hop count to each RS. The NTM node, upon receiving the NTM Survey Direction, sends an ICMP Echo Request to each RS in order to survey the hop count, and receives an ICMP Echo Reply from each RS. Then, the NTM node calculates the hop count from the difference between the TTL value in the IP header of the ICMP Echo Reply and the initial value of the TTL. The NTM node describes in the NTM Survey Report the IP address of the RS and the hop count from the NTM node to the RS, and reports the result to the DC. The DC records the hop count between the NTM node and the RS in the Hop Table. The DC, upon receiving an NTM Direction Request from the MN, selects the optimal RS with the smallest number of hops from the Hop Table. The DC searches information on the hop count between from the MN and each of the RSs and that between the CN and each of the RSs. Then, it calculates the hop count for the entire communication route, by adding the hop count between the MN and each of the RSs and that between the CN and each of the RSs. The smallest among the calculated total number of hops for the entire communication route, is chosen.

B. Survey of the number of hops in the case of communication between an NTM node and a GS

Fig. 2 shows the sequence of the survey of the hop counts between RSs and a GS. While the timing of the survey of the hop count described in Fig. 1 is at the start-up time of the NTM node, that in Fig. 2 is at the time of starting communication with the GS. The DC makes name resolution

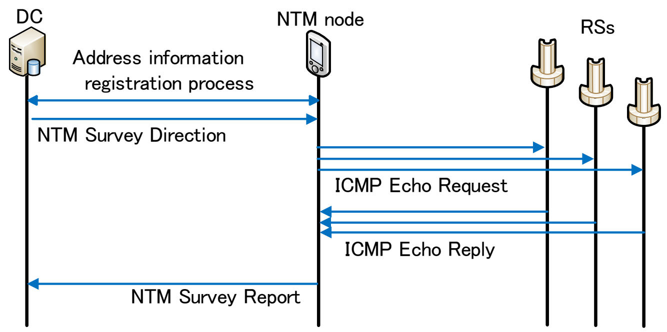

Fig. 1. Sequence of the survey of the number of hops between the NTM node and RSs

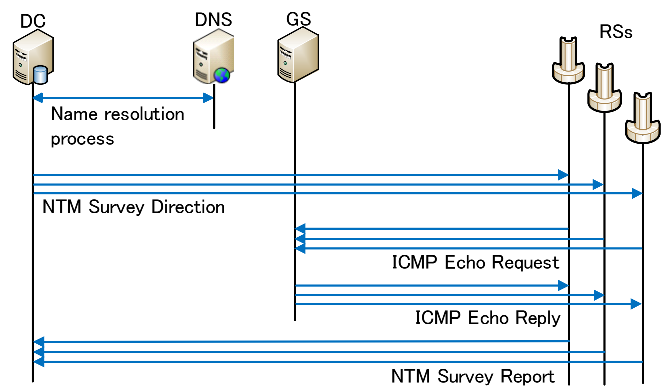

Fig. 2. Sequence of the survey of the number of hops between RSs and the GS

processing with the general DNS server in order to get the IP address of the GS. After the DC has acquired the address of GS, it initiates the survey of the hop count between the GS and RSs. The DC sends NTM Survey Directions with the IP address of the GS to the RSs. Then, each RS, upon receiving the NTM Survey Direction, sends an ICMP Echo Request to the GS. Each RS, upon receiving an ICMP Echo Relay, calculates the hop count from the TTL value. Thereafter, RSs report the hop count to the DC by NTM Survey Report. The DC then records the hop count between RSs and the GS in the Hop Table. After the surveying the hop count, the DC chooses RS, whose hop count is the smallest, from the Hop Table. Here, depending on the GS, there may be a case where the GS is set in the network which an ICMP packet cannot go through. In such a case, the RS, whose hop count between the MN and the RS is the smallest, is selected.

IV. Implementation

A. Implementation of the DC

Fig. 3 shows the module configuration of the DC. The DC is composed of an NTM daemon which has the function of sending and receiving control messages in the user space and the DNS server using BIND. We implemented the function of a Route Survey to the NTM daemon of the DC as a module

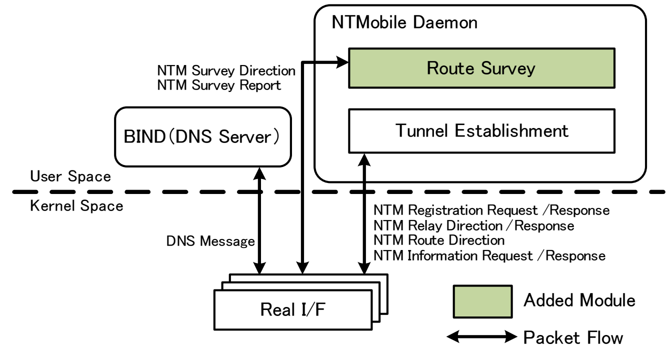

Fig. 3. Module configuration of the DC

to perform the survey of the hop count.

B. Implementation of the RS

The RS is composed of an NTM deamon in the user space, and an NTM kernel module in the kernel space. As regards the RS, we implemented the function of a Route Survey in the NTM demon as a module to perform the survey of the hop count.

In the case that the route survey is performed between the GS and the RS, we made it possible to obtain TTL values from the IP header, by sending and receiving an ICMP Echo Request and a Reply by way of Raw sockets.

V. Conclusion

In this Paper, we proposed a method of solving the problem of redundant communication route through an RS at the time of communication between NTM nodes, as well as that between an NTM node and a GS. Based on the proposed method, we established a system of finding the optimal route regardless of the configuration of the node and connected networks. Hereafter, we plan to evaluate our system in the real environment.

Acknowledgment

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