A method to improve network performance of Proxy Mobile IPv6

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***Abstract*— PMIPv6 (Proxy Mobile IPv6) is one of techniques to realize network-based handover. However, PMIPv6 has a problem that it is necessary for all communication of the mobile terminals to pass through a proxy server. Therefore, the network performance is declined in applying the PMIPv6. To approach this issue, we propose a method to apply the OpenFlow technique to the PMIPv6 network. We make experiments to evaluate the communication performance of the proposed method comparing with existing methods. We show that the communication performance of the proposed method is higher than the existing methods.**

Keywords—Handover; Network-based handover; Proxy Mobile IPv6; OpenFlow; Route optimization;

1. INTRODUCTION

In recent years, the number of people using mobile terminals has increased. In the future, it is expected that the number of people who use the Internet in outside will increase because it will become easier to access there. Handover is a technique which is used for continuing the communication of the mobile terminals. It is important for the handover technique to maintain communication even if the mobile terminals move between base stations. There are some protocols which support the handover technique. Proxy Mobile IPv6 (PMIPv6) [1] is one of the protocols which is used for performing a network-based handover to switch the communication path of the mobile terminals. However, there is a problem that all communication of the mobile terminals pass through a proxy server called Local Mobility Anchor (LMA).

In this paper, we propose a method to apply OpenFlow [2] technique to the PMIPv6 network without implementation on the mobile terminals.

2. BASIC TECHNOLOGY

2.1. OpenFlow

OpenFlow is a new technique that has been standardized to be controlled by the network using software. One of the features of OpenFlow technique is that it separates the functions of the network devices which forward packets into two different categories: the path control function unit of the packets which is called the control plane, and the data transfer function unit which is called the data plane. OpenFlow is composed of OpenFlow Switch and OpenFlow Controller. OpenFlow Switch performs the transfer processing of the packets. OpenFlow Controller is in charge of directing the transfer of the packets to each of the OpenFlow Switches.

2.2. Proxy Mobile IPv6

The PMIPv6 is one of the protocols which supports handover technique. It supports the movement of Mobile Node (MN) on the network, using only the network's own processing mechanism. It is composed of LMA and Mobile Access Gateway (MAG). LMA, MAG, and the network which accommodates MNs are called "PMIPv6 domain". LMA has a function of relaying IP packets between the MN and the Correspondent Node (CN) in PMIPv6 domain. The MAG has a function as the default gateway of the MN.

However, the PMIPv6 has some problems. Firstly, the communication path is redundant. Secondly, the processing load on the LMA is increased. Finally, the communication delay is increased by the tunneling process between the LMA to the MAG.

3. RELATED RESEARCH

Proxy Mobile IPv6 Route Optimization (PRO) [3] mentioned a problem that it is a cause of a reduction in network performance because the communication paths of MNs are redundant in PMIPv6 domain. To solve this issue, PRO realizes direct communication by creating a bi-directional tunnel between MAG connected to CN and MAG connected to MN. Thus, the network performance is improved and the communication path is optimized.

However, the PRO has some problems. One of them is that CN must be present in PMIPv6 domain. The other problem is that processing overheads increase due to the messages required for creating a bi-directional tunnel.

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4. Proposed Method

In the proposed method, we construct a communication path that does not pass through LMA. To achieve this purpose, we focus on OpenFlow technique. It is possible to construct a communication path that does not pass through the LMA by applying OpenFlow to PMIPv6 domain. Furthermore, it is possible to communicate with MN without the tunneling process. Therefore, the processing load of the LMA is reduced, and network performance can be expected to be improved. Figure 1 shows a basic handover sequence of the proposed method.

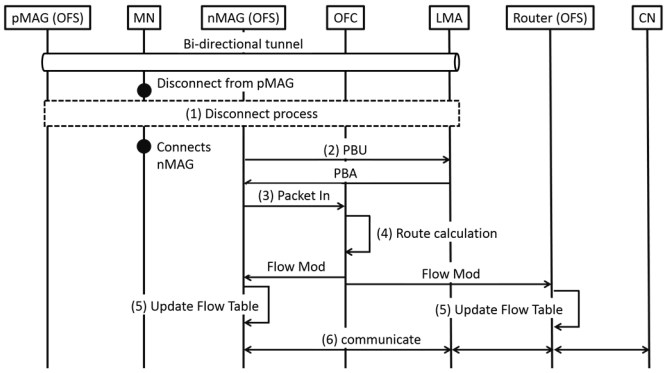

Figure 1. Basic sequence of the proposal method

5. Experiment

The scenario of experiment is that a MN moves between a base station to the other base station while communicates to the CN using FTP by simulator. Figure 2 shows average throughput of PMIPv6, PRO, and the proposed method. Table 1 shows the overhead packets of each method.

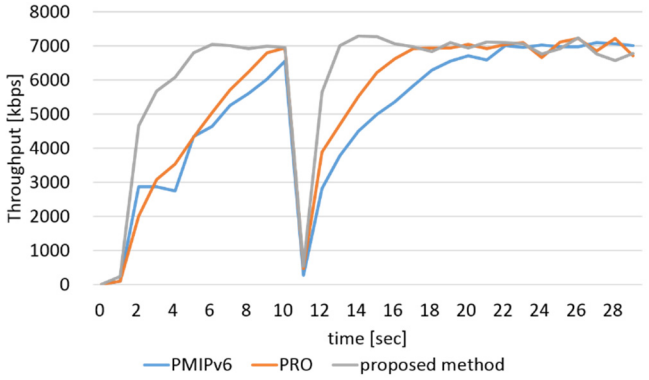

Figure 2. Average throughput of each method

Table 1. Number of overhead packets

Method	Overhead Packets
PMIPv6	2
PRO	14
proposed method	4

The total throughput of the proposed method is higher than the other methods. The total throughput of the proposed method is about 1.1 times to PRO, and about 1.2 times to the PMIPv6. However, the throughput of each method is zero at 11 second. The throughput of the proposed method reaches the upper limit at 4 seconds, it is faster than the other methods. The overhead packets of the proposed method are about 1/3 times to PRO, but 2 times to PMIPv6. In conclusion, the total throughput of the proposed method is the highest, although the overhead packets are increased more than PMIPv6.

6. Discussion

First, a possible explanation for this results is what the total throughput of the proposed method is higher than other methods. Next, the time when throughput of the proposed method reaches upper limit is faster than the other methods for 4 seconds. Last, the overhead packets reduced than the PRO. Therefore, the communication path of the proposed method can optimize, and the overhead packets can reduce. However, the throughput of the each method is zero at 11 second. This is because the instantaneous disconnect of communication by the handover occurs. In addition, the overhead packets of the proposed method are 4 packets, and the PMIPv6 is 2 packets. The throughput of the proposed method reaches the upper limit is faster than the PMIPv6. This is because the network performance is higher than the PMIPv6 even if the overhead packets is bigger than the PMIPv6.

7. Conclusion

In this paper, we proposed a method to optimize the communication path by applying the OpenFlow to PMIPv6 network, and to resolve the problem that occurs when using PRO and PMIPv6 during handover. Furthermore, we experimented to evaluate the utility of the proposed method compared with PMIPv6 or PRO. The results show that it is possible to solve the problem of PMIPv6 and PRO by using the proposed method, and the network performance is improved. Therefore, it is found that the proposed method has good utility comparing to PRO and PMIPv6. In the future, we will consider whether the proposed method can realize soft handover with no disconnection time by adapting application method of the OpenFlow.

References

[1] S. Gundavelli, K. Leung, V. Devarapalli, K. Chowhury, B. Patil, “Proxy Mobile IPv6”, IETF RFC 5213, Aug. 2008.

[2] N. McKeown, T. Anderson, H. Balakrishnan, G. Parulkar, L. Peterson, J. Lexford, S. Shenker, and J. Turner. “OpenFlow: enabling innovation in campus networks,” *ACM SIGCOMM Computer Communication Review*, vol. 38, no. 2, pp. 69‑74, March. 2008.

[3] J. Abeille and M. Liebsch, “Route optimization for proxy mobile IPv6,” draft-abeille-netlmm-proxymip6ro-01.txt, Nov. 2007