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Performance analysis of DNS-assisted global mobility management scheme in cost-optimized proxy mobile IPv6 Networks

Chulhee Cho [a], Jeong-Jin Kang [b], Jongpil Jeong [c,*]

[a] Graduate School of Information and Communications, Sungkyunkwan University, Seoul 110-745, Republic of Korea
[b] Department of Information and Communication, Dong Seoul University, Seongnam, Gyeonggi-Province 461-714, Republic of Korea
[c] College of Information and Communications, Sungkyunkwan University, Suwon, Kyunggi-do 440-745, Republic of Korea

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ABSTRACT

Proxy Mobile IPv6 (PMIPv6) is designed to provide a network-based localized mobility management protocol, but it does not handle the global mobility of hosts. In this paper, we propose a location management scheme based on Domain Name System (DNS) for PMIPv6. In this proposed scheme, DNS as a location manager provides PMIPv6 for global mobility. In addition, a paging extension scheme is introduced to PMIPv6 in order to support large numbers of mobile terminals and enhance network scalability. To evaluate the proposed location management scheme, we establish an analytical model, also formulate the location update and the paging cost, and analyse the influence of the different factors on the total signalling cost. The performance results show how the total signal cost changes under various parameters.

1. Introduction

The network-based localized mobility management (NETLMM) working group standardized a NETLMM protocol called PMIPv6 [1], where local IP mobility is handled without involvement from the mobile node. Compared to host-based mobility management approaches such as Mobile IPv6 (MIPv6), PMIPv6 has fundamental advantages [2]. The MN is not required to participate in any mobility-related signalling, which reduces signalling cost in wireless links and takes advantage of wireless resources efficiently. Secondly, PMIPv6 does not require any modification of the MN, because it could distribute services to various types of terminals. Finally, as a network-based mobility management protocol, PMIPv6 makes it possible to handle the network easily, because it can control the network traffic [3]. However, PMIPv6 has some disadvantages as well. One is that PMIPv6 does not currently provide the global mobility of hosts [1,4]. PMIPv6 is designed to give network-based mobility management support to an MN in a topologically localized domain. The current PMIPv6 does not make an appropriate solution for the case of inter-mobility from one domain to others. Thus, we have to introduce a network entity to be in charge of a global location manager to PMIPv6. Most methods of communication in the current Internet start with a name lookup via DNS in order to translate a domain name into an IP address. DNS is used widely, so it could globally locate an MN. [5] suggested a feasible solution without new entities using the DNS as a location manager. Thus, in order to support global mobility in PMIPv6, we bring in a DNS that performs the role of a location manager. Another drawback is that PMIPv6 supports registration but not paging [6], which could reduce the location update cost and power consumption of MNs. Paging technology has other features

* Corresponding author.
E-mail addresses: tgb017@nate.com (C. Cho), jjkang@du.ac.kr (J.-J. Kang), jpjeong@skku.edu (J. Jeong).

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that expand the scalability of the protocol and handle numerous mobile nodes used widely in cellular systems [7,8]. Therefore, we propose a paging extension scheme in order to optimize mobility management performance in PMIPv6. In this paper, we propose a location management scheme for PMIPv6 called D-PMIPv6, which is based on DNS and a paging extension scheme. In addition, in order to evaluate the location management scheme, we establish an analytical model. From this model, we formulate the location update cost and the paging cost and explain how the PMIPv6 domain, mobility rate, session arriving rate, and active mode rate affect the total signalling cost with various parameters. We also propose a DNS security extension called DNSSEC in order to improve the security. The DNS protocol was designed without security as a central concern, and a variety of possible attacks against DNS have been identified [9]. The rest of this paper is organized as follows. Section 2 shows a brief overview of PMIPv6. Section 3 gives the details for location management mechanism based on DNS. Section 4 discusses the security analysis, while Section 5 formulates an analytical model and the signalling cost. Section 6 evaluates the performance results. Finally, in Section 7 we present the conclusion.

2. Overview of PMIPv6

In this section, we give a short overview of PMIPv6, as shown in Fig. 1. PMIPv6 is designed to provide a network-based IP mobility PMIPv6 domain architecture. The PMIPv6 domain consists of two core functional elements: the Local Mobility Anchor (LMA) and the Mobile Access Gateway (MAG). The LMA manages the Home Agent and Binding Cache Entry of a currently registered MN. Meanwhile, the LMA handles possibility. Wherever the MN moves within the PMPv6 domain, it is managed by the LMA. The main role of the MAG is to detect the MN's movements and manage the mobility-related signalling on behalf of the MN. In PMIPv6, as an MN first reaches a MAG in the PMIPv6 domain, it sends a router solicitation (RS) message to the MAG. After the MN passes an access authentication procedure, the MAG obtains the MN's profile, which includes the MN identifier, which is the LMA's address. Afterwards, the MAG sends a proxy binding update (PBU) message on behalf of the MN to its LMA. On receiving the PBU message, the LMA sends the proxy binding acknowledgement (PBA) message including the MN's home network prefix to the MAG. At the same time, the LMA records the MN's information in the binding cache entry and establishes a bi-directional tunnel between the LMA and the MAG. Once the MAG receives the PBA message, it sends a router advertisement (RA) message to the MN and sets up a bi-directional tunnel. After receiving the RA message, which contains the home network prefix, the MN can configure its proxy home address (*p*HoA). After an MN obtains a *p*HoA in the PMIPv6 domain, it can send and receive data traffic with its *p*HoA. The LMA receives all of the data packets sent by the MN to the MN, and then forwards the received packets to the MAG through the tunnel. After receiving the packets, the MAG on the other end of the tunnel removes the outer header and forwards the packets to the MN.

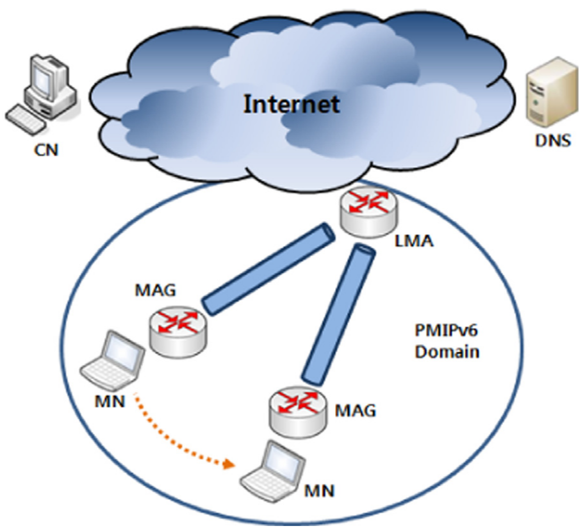

Fig. 1. PMIPv6 domain architecture.

3. A novel location management scheme based on DNS in PMIPv6

In this section, we suggest a location management scheme based on DNS for PMIPv6. Under this new scheme, DNS is in charge of the global location manager, and an extended location update scheme needs to replace the currently existing one. In addition, a paging scheme is introduced to PMIPv6.

3.1. DNS as location manager for PMIPv6

PMIPv6 has a feature that does not support global mobility of hosts [10]. Under this circumstance, we need to consider bringing in a network entity as the global location manager. DNS is already a part of the existing Internet infrastructure, and most communications in the traditional Internet start with a name lookup via DNS to translate the Fully Qualified Domain Name (FQDN) to an IP address. Therefore, DNS could be supposed as a location manager for supporting global mobility in PMIPv6. The DNS as location manager contains two operations: location update and location search [6].

3.1.1. Location update

In PMIPv6, when an MN hands off in the same PMIPv6 domain, there is no need to change its address. As a result, the FQDN-to-IP entry in the DNS does not need to change either. However, if an MN moves into a different PMIPv6 domain, it obtains a new address from the current home network prefix. Then, the MN updates DNS's FQDN-to-IP entry with its new address by sending DNS UPDATE messages.

3.1.2. Location search

When communicating with an MN, the host checks for DNS's FQDN-to-IP entry. After the DNS responds with the current IP address of the MN, the host can initiate and