A New Multicast Group Management Scheme for IP Mobility Support

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Abstract. As the number of portable devices roaming across the Internet increases, the problem of routing packets to mobile hosts generates increasing research and commercial interest. To support mobility more effectively for seamless provision of various applications, many multicast-based localized mobility support schemes have been proposed to achieve better performance than the basic solutions provided by the IETF, such as Mobile IP and Mobile IPv6. However, any multicast-based scheme inherently introduces significant bandwidth wastage at the wireless access network due to long leave latency. In this paper, we propose a new multicast group management scheme that is tailored for managing multicast groups used to support host mobility. It has been shown by simulation that the proposed scheme achieves extremely short leave latency and eliminates bandwidth wastage in the wireless links.

1 Introduction

As Internet places itself as an indispensable factor in today’s life, it is expected that future wireless networks will include large number of IP-enabled mobile devices roaming round wireless cells while the devices maintain connections with others using TCP/IP protocol suite. Consequently, providing Internet data services is recognized as an important service in the next generation wireless communication networks. To realize such mobile Internet services that are comparable to the current wired network environment, providing efficient mobility management schemes is essential.

The main problem in supporting mobility in the Internet is created by the location dependency of addresses and by the violation of the layered concept in TCP/IP protocol suite. Location dependent IP unicast address poses problems when an IP enabled host changes its point of attachment from one network to another network. Also, since IP addresses are often used to identify connections in the transport and application layers, the higher layer identifiers are required to be modified and the corresponding connections re-established whenever a node moves [1]. Solutions for this problem made by IETF Mobile IP working group

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are Mobile IP [2] and Mobile IPv6 [3] which use two-tier addressing [4]; one for routing directive and the other for end-point identifier. In these solutions, a mobile node (MN) has a home address. It also has a care-of address (CoA) while it is away from home. Routing of packets heading for the MN is enabled by maintaining mapping between the home address and the CoA at the home agent (HA) and tunneling packets to the proper CoA by the home agent. The service of Mobile IP and Mobile IPv6 is restricted in delivering packets with unicast routable addresses. Therefore, the home address and the CoA used by the mobil node should be globally routable unicast addresses.

Though Mobile IP and Mobile IPv6 provide basic mobility support for the wide area movement, they cannot support fast user mobility efficiently and generate quite number of signaling messages in the Internet backbone. Since IP multicast provides a mechanism for location independent addressing and packet delivery to multicast group members, it has been considered as a mechanism for providing IP mobility. Many multicast-based proposals [1,5,6,7,8,9] have been made for supporting host mobility. One of main reasons to use multicast in Internet host mobility is its shorter delay in location registration than Mobile IP or Mobile IPv6. However, utilizing multicast for the host mobility support accompanies signaling traffic to maintain multicast tree and multicast group membership status as well as bandwidth wastage due to leave latency.

A multicast group address to be used for mobility support can be dynamically allocated or automatically configured. For the dynamic allocation, a mobile node should consult a server to lease a multicast group address. Such procedure introduces delays in mobile node’s location registration. As a result, automatic configuration by mobile nodes [8,9] is a better solution for the host mobility support. If multicast is used for mobility support to compensate the drawbacks of Mobile IP or Mobile IPv6, the multicast group address that is used by a mobile node should be unique in the multicast domain. In other words, each multicast group formed for mobility support has only one member in the multicast domain. The reason for that is to preserve the objective of Mobile IP and Mobile IPv6 to serve packets with unicast routable addresses. In IPv4, a mobile node cannot configure a unique multicast address automatically because of the limitation in the IP address space. On the other hand, there is no ambiguity in automatic configuration of multicast group addresses in IPv6. So, this paper addresses issues and solutions in terms of IPv6. However, the basic idea can easily adapted in IPv4 if a uniqueness of multicast group addresses is guaranteed.

One of the main concerns in using multicast for mobility management scheme is leave latency. Leave latency is the time between the moment the last node on a link ceases listening to a particular multicast address and the moment the routing protocol is notified that there is no longer any group member for that address. Since any host mobility support scheme using multicast results multicast groups with a single member, mobile node’s movement from one subnet to another triggers a leave process. In this case, long leave latency can result significant bandwidth wastage in the link between the multicast router and the mobile node, since leave latency can be from several seconds to several minutes. So, we