Mobile IP에서 기설정된 전달 트리를 이용한 멀티캐스팅 방안

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Preconfigured Multicast Delivery Tree in Mobile IP

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Abstract

Multicasting over mobile IP network becomes more important with the increasing needs of supporting multimedia services in mobile network. The IETF has suggested two approaches which are remote subscription and bidirectional tunneling for supporting mobility management in multicasting over mobile IP. But, these protocols have problems – the frequent reconstruction of multicast delivery tree, packet loss during handoff, convergence problem, and so on. In this paper, we propose to use preconfiguration of multicast delivery tree when mobile host enters the foreign network. It will decrease the frequency of multicast delivery tree reconstruction, and reduce the packet loss during handoff. Also the multicast delivery tree maintained by Keep Alive messages makes the signaling overload of networks diminished.

1. INTRODUCTION

With the increasing of demands of multimedia service, Internet broadcasting, audio/video conferencing, multiplayer online gaming and etc., multicasting could prove to be an efficient way of providing necessary services for these applications. Multicasting, which is the process of sending messages from one source to multiple destinations using the same IP address, is necessary for supporting mobile IP based network [1,2].

The IETF has proposed two approaches to provide multicast over Mobile IP [3]. They are called bidirectional tunneling and remote subscription. In bidirectional tunneling, Mobile Hosts (MHs) send and receive the packet by way of their Home Agents (HAs), using unicast mobile IP tunnels from their HAs. All subscription of the MH is done through the HA, so the multicast delivery tree will not be updated [4]. But, the routing path for multicast delivery can be far from optimal, and tunnel convergence problem may occur. In remote subscription, MHs resubscribe to the multicast group whenever they move to the new foreign network. Although the multicast datagrams are always delivered on the shortest paths, this approach may lead to lost packets and result in substantial control overhead since frequent resubscription in each foreign network [5,6,7,8].

Our proposal is based on remote subscription. It previously makes a multicast delivery tree of MH's multicast group ID not only in the MH's FA but also in its neighboring FA. The FA having a multicasting MH operates as the Active Foreign Agent (Active-FA) and it sends Keep Alive messages to its neighboring FAs (Standby Foreign Agent, Standby-FA) to hold the MH's multicast delivery tree. When a MH moves to a new Standby-FA, it receives multicast packet from the Active-FA as well as the Standby-FA until handoff completion. The proposed scheme will decrease the frequency of multicast delivery tree reconstruction, and reduce the packet loss during handoff. And, the number of Standby-FAs will remain constant, because Standby-FAs that don't receive Keep Alive message are removed from multicast group entry and changed to normal FA. It makes the signaling overload of networks diminished.

This paper is organized as follows. Section 2 describes some background of multicast over mobile IP, and shows the various proposals of supporting mobility management for multicast. Section 3 explains the proposed scheme being divided into two phases. First phase is joining procedure of multicast group. Second phase is the handoff process of the proposed scheme. Finally, we conclude this paper in section 4.

2. MULTICAST OVER MOBILE IP

In this section, we describe existing multicast routing protocols in mobile environment.

2.1 Remote Subscription

This approach is based on FA. In this approach, each MH always resubscribes to the desired multicast group when it moves to a new foreign network. It is the simplest way of providing multicast through Mobile IP.

The main advantage of this approach is that the multicast datagrams are always delivered on the shortest paths. However, this approach is not suitable for highly mobile users since frequent resubscription in each foreign network may lead to packet loss. And, frequent reconfiguration of the multicast delivery tree may result in substantial control overhead.

2.2 Bidirectional Tunneling

This approach is based on HA. All subscription of the MH is done through the HA. Therefore, the multicast delivery tree will not be updated. The drawback of this approach is the routing path for multicast delivery which can be far from optimal. In addition, when MHs which belong to different HAs move to the same FA, all of the tunnels from different HAs to the FA would carry the same multicast datagram. As the result, the network resource will be wasted. This is called the tunnel convergence problem.

3. PROPOSED SCHEME

Our proposal, based on Remote Subscription, is that a multicast delivery tree of a MH is preconfigured not only in the FA which the MH currently attaches to, but also in its neighboring FAs.

At first, we will show the schematic characteristics and explain two phases of the proposed scheme. First phase is the step that the MH subscribes into the FA as a multicast group and leaves from the FA. Second phase is the handoff procedure. It is supposed that all FAs are multicast routers in this approach. And the Active-FA is a FA that receives a request to join the multicast group from a MH. The Standby-FAs are neighboring FAs of the Active-FA and receives a request from the Active-FA to configure the multicast delivery tree.

3.1 Schematic Characteristics

1) Preconfiguration of multicast delivery tree : If a MH requests to join a multicast group, the Active-FA with the MHs sends the multicast group ID to its neighboring FAs(Standby-FAs). Standby-FAs will update multicast delivery tree by getting multicast group ID from the Active-FA.

During handoff, The MH holds connection not only with the Active-FA, but also with Standby-FAs. The MH will receive multicast packets from both the Active-FA and Standby-FAs until moving to the new FA region entirely.

2) Keep Alive Messages : Standby-FAs will receive periodically Keep Alive messages from the Active-FA. Then they will set the Keep Alive timer which is used to maintain virtual connections between the Active-FA and Standby-FAs. If the Standby-FA doesn't receive Keep Alive message, it will be changed as normal FA. When the MH moves to new foreign network, the FA will be a new Active-FA and it will send Keep Alive messages to its new neighboring FAs.

3.2 PHASE I - The Procedure of Joining a Multicast Group

As the MH wants to join a multicast group, it uses Internet Group Management Protocol (IGMP) like Remote Subscription as stated in section II. When a MH sends IGMP report messages to the FA for joining a multicast group, the FA becomes an Active-FA. It configures multicast delivery tree and sends multicast group ID to Standby-FAs for configuring multicast delivery tree (Fig. 1).

If the Standby-FA receives a request message to join a multicast tree about any multicast group from the Active-FA, it may search for upper multicast router having the shortest path about the multicast group and then preconfigure multicast delivery tree by means of registering upper multicast router's table.

The Standby-FA has the timer of Keep Alive messages and receives the messages from the Active-FA within a timeout period. If the timer is expired, the Standby-FA will request upper multicast router to eliminate multicast delivery tree table and leave the membership of the multicast delivery tree (Fig. 2).

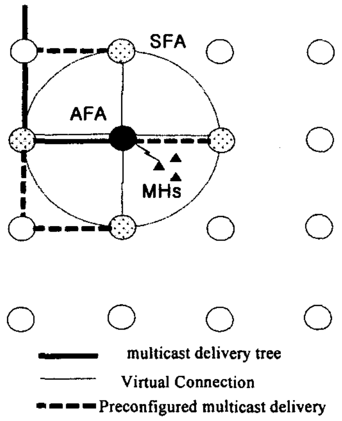

Figure 1. Preconfigured multicast delivery tree

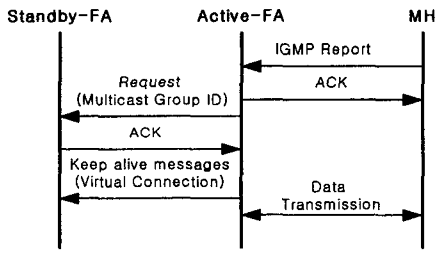

Figure 2. The procedure of joining a multicast group

3.3 PHASE II - The Procedure of Handoff

The existing remote subscription causes packet loss because it has the reconfiguration time of multicast delivery tree and the performance may be fallen down during the continuous handoff.

In the proposed scheme, the handoff procedure of the MH is as follows. When a MH moving from the Active-FA to the Standby-FA exists in the common region of both the Active-FA and the Standby-FA, it receives multicast packets from both the Active-FA and the Standby-FA at the same time. When the MH only receives the packet from the Standby-FA when the MH moves perfectly into the Standby-FA's region. The FA where the MH is currently attached will be changed from the Standby-FA to the new Active-FA (Fig. 3).

A previous Active-FA from which the MH departs will become the Standby-FA and the previous Standby-FA near to the previous Active-FA (current Standby-FA) may not receive a Keep Alive message from the previous Active-FA. So, timeout will happen in the previous Standby-FA and the previous Standby-FA leaves the multicast group entry of the previous MH

A new Active-FA in which the MH resides sends its neighboring FAs multicast group ID to configure multicast delivery tree as being mentioned in Phase I. Then the Active-FA will periodically send Keep Alive messages to its neighboring Standby-FAs to hold the multicast delivery tree (Fig

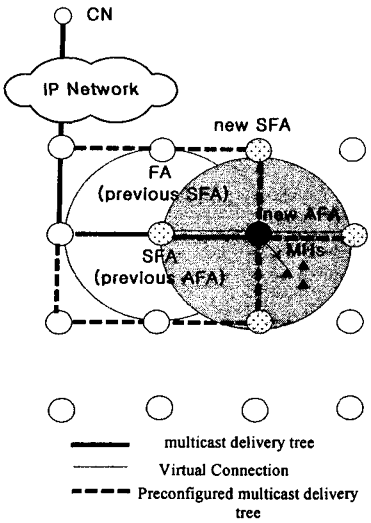

Figure 3. Preconfigured multicast delivery tree in handoff

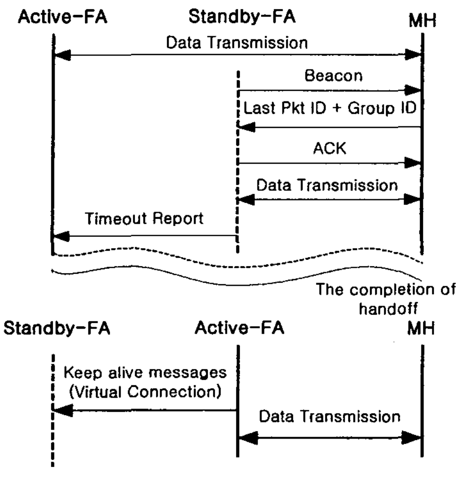

Figure 4. The handoff procedure

4).

The proposed scheme will decrease the frequency of multicast delivery tree reconstruction, reduce the packet loss, and guarantee the seamless service during handoff by using preconfiguration multicast delivery tree. Because Standby-FAs that don't receive the Keep Alive message are removed from multicast group entry and changed to normal FA, the number of Standby-FAs will remain constant. It will make the signaling overload of networks diminished. We are currently performing simulations of our proposed scheme, and the results will appear in a forthcoming paper.

4. CONCLUSION

In this work, we have addressed the issues associates with providing IP multicast service to the mobile host. We propose a scheme that supports preconfiguration multicast delivery tree and sending/receiving Keep Alive message. The proposed scheme will decrease the frequency of multicast delivery tree reconstruction, and reduce the packet loss during handoff. Also, the signaling overload of network will be diminished using Keep Alive messages, because the number of Standby-FAs which is virtually connected with the current Active-FA will remain constant.

REFERENCES

[1] H. Gossain., C. de Morais Cordeiro and D. P. Agrawal, "Multicast : wired to wireless," *IEEE Communications Magazine*, pp.2-9, June 2002.

[2] V. Chikarmane, R. Bunt and C. Williamson, "Mobile IP-based multicast as a service for mobile hosts," IEEE Services in Distributed and Networked Environments, Second International Workshop on 1995, pp.11-18.

[3] C. Perkins, "IP mobility support," RFC 2002.

[4] C. Perkins and K. Y. Wang, "Optimized smooth handoffs in mobile IP", IEEE International Symposium on Computers and Communications, pp. 340-346, 1999.

[5] H. Gossain, S. Kamat and D. P. Agrawal, "A framework for handling multicast source movement over mobile IP," IEEE ICC, pp.3398-3402, May 2002.

[6] J. R. Lai and W. Liao, "Mobile multicast with routing optimization for recipient mobility," *IEEE Transactions on Consumer Electronics*, vol.47, no.1, pp.199-206, Feb. 2001.

[7] W. Liao, K. Chien-An and L. Jiunn-Ru, "Reliable multicast with host mobility," IEEE GLOBECOM '00. vol. 3, pp.1692-1696, 2000.

[8] C. R. Lin and K. M. Wang, "Mobile multicast support in IP networks," IEEE INFOCOM 2000, vol. 3, pp.1664-1672, 2000