Fast Tree Join for Seamless Multicast Handover in Wireless/Mobile Networks
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Abstract

This draft describes a fast handover mechanism to provide seamless multicast services in the wireless/mobile networks based on the Fast Mobile IPv6 (FMIPv6). When a mobile node (MN) moves from one access router to another, it may encounter data loss. In the tree joining case of the existing scheme, there is a problem of buffer overflow during the packet forwarding from Previous Access Router (PAR) to New Access Router (NAR), in which many packet losses may occur due to the buffer overflow. In order to reduce this buffer overflow and the concerned packet losses, we propose a new scheme of a fast tree join for seamless multicast handover, which allows the NAR to join the multicast tree before the FMIPv6 handover is completed. In the proposed scheme, we consider the two specific cases: 1) the short tree joining time, in which no packet forwarding will be required and thus NAR can receive the multicast data from an upstream multicast router before the FMIPv6 handover is completed, 2) the long tree joining time, in which the packet forwarding will be required and thus NAR will receive the multicast data after the FMIPv6 handover.

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1. Introduction

The wireless data communication technologies are rapidly growing in the communication industry [1]. Therefore, the movement or handover in the wireless networks becomes one of the crucial issues to be addressed [2]. The movement in the wireless/mobile networks can be managed by using the Mobile IP (MIPv6) [3]. The MIPv6 was designed to manage the movement of MN from one access router to another. To improve the handover performance of MIPv6, the Fast Mobile IP (FMIPv6) was proposed [4].

In the modern era of data communication technology, the users have demanded the multicast services in the wireless mobile networks, such as Internet broadcasting and multiple video/audio conferencing. Some schemes are needed to support the mobile multicasting such as
construction of a multicast tree, the delivery of multicast data, and joining and leaving the multicast group [5].

This internet draft, describes a fast join to multicast tree for seamless multicast handover to reduce handover latency with packet losses and the signaling costs required for multicast handover.

The FMIPv6 is an extension of MIPv6 [4]. FMIPv6 can support the fast handover, and reduce the handover latency and data loss. FMIPv6 can also be used for fast handover of multicast sessions. Some works for multicast fast handover have been proposed. One of these schemes the work in [6] proposed to use the multicast group information option in the fast binding update message (FBU) and in the handover initiation message (HI). In the scheme, the PAR transmits the multicast group information to the NAR through FBU, which may has taken a long join delay. Recently, another scheme has been proposed for efficient multicast [1], which introduced the new multicast options in the mobility header to record the multicast group information. This scheme also establishes a tunnel between PAR and NAR.

We note that a scheme of FMIPv6-based multicast handover that was proposed in [7], where the ‘’Fast handover based on Mobile IP for Multicasting’’ (denoted by FMIP-M) scheme, as presented in Fig. 1
<table>
<thead>
<tr>
<th>MN</th>
<th>PAR</th>
<th>NAR</th>
<th>HA</th>
<th>RP</th>
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<td>&quot;&lt;---HACK---------&quot;</td>
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<td>&quot;&lt;--FBACK--&quot; &quot;---FBACK---&quot;</td>
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Disconnect |     |     |    |    |
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|     | "=Packet Forwarding==>" |     |    |    |
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|     | " " | " " | " " | " " |

Connect |     |     |    |    |
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Figure 1. Existing FMIP-M scheme
In the FMIP-M scheme, MN receives an L2 trigger and sends a Router Solicitation for Proxy (RtSolPr) to the PAR. The PAR replies to MN with a Proxy Router Advertisement (PrRtAdv). MN then obtains a new care of address (nCoA). The fast handover procedure actually starts by sending a Fast Binding Update (FBU) message towards PAR that contains a multicast group address. Given the information contained in the FBU message, PAR sends a Handover Initiation (HI) message to NAR. The HI message contains the information about Multicast Status (M-Status), Hop Count (HC) from the multicast tree, and multicast group address. The NAR will check the validity and uniqueness of the nCoA. After that, NAR can reply to the PAR with a Handover acknowledgement (HACK) message. It contains the M-Dec field, which indicates a specific method used by NAR for multicast handover. In addition, the HACK message may also contain the information of the sequence number of data packets that will be maintained in the new access router’s buffer (denoted by SEQNARBuff in [7]), which is used only when the M-Dec is set to 3. This SEQNARBuff represents the sequence number of the first packet that will be stored in the NAR buffer. The PAR then sends the Fast Binding Acknowledge (F-BACK) message to MN and NAR both.

After sending the F-BACK message, the PAR begins to forward the multicast data packets to NAR, in which the four specific cases can be considered, as described in [7], which will be indicated by using the M-Dec field of the HACK message. These four schemes can be summarized as follows:

- **Case 1 (Path Extension)**, in which the multicast service path is extended from PAR to NAR. In this case, after the PAR received this decision from the HACK message, the PAR started to forward the multicast packets to NAR. This packet forwarding is performed until NAR requests PAR to terminate the path extension;
- **Case 2 (Bi-directional tunneling from Home Agent (HA))**, in which in this case, the PAR starts to forward the multicast packets (received via the bi-directional tunneling) from the HA to NAR. This packet forwarding will be continued until PAR receives the HO COMPLETE message from NAR.
- **Case 3 (Remote Subscription)**, in which NAR sends a tree join message (PIM JOIN) to the upstream multicast source, which is indicated as Rendezvous Point (RP) in Fig. 1. For the join message, the RP will respond to NAR with a Join Ack (PIM JOIN-ACK) message, and then the multicast data packets are now delivered to the NAR by using the newly configured multicast tree. In this case, the PAR will also forward the multicast packets, if any, to NAR.

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. Case 4, in which it is assumed that one of the users in the NAR region has already joined the same multicast group and thus the NAR is receiving the corresponding group data packets. So, in this case, the PAR had only to forward the previously buffered multicast packets to NAR.

On the other hand, when MN moves to the new network, it will send an Unsolicited Neighbor Advertisement (UNA) message to the NAR to indicate that the handover has been completed, as done in the FMIPv6.

It is noted that the existing scheme may incur the ‘buffer overflow problem’ in the buffer of PAR during the tree join process. That is, if the tree join by NAR to RP takes a long time, the buffer of PAR for packet forwarding may overflow and thus a significant amount of data packets could be lost. In addition, the existing scheme also tends to give have the large signaling and packet forwarding costs.

In this draft, we propose a fast tree join scheme for seamless multicast handover, in which the NAR will try to join the multicast tree as soon as the handover event is detected (i.e., when NAR receives the HI message from the PAR). The proposed scheme can also reduce the signaling costs associated with the multicast handover.

2. Conventions used in this document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC-2119 Error! Reference source not found..

3. Fast Tree Join for FMIPv6 Multicast Handover

In this draft, we describe a fast tree join (FTJ) scheme for seamless multicast handover based on the FMIPv6 protocol, which is denoted by FTJ-FMIP in this paper. The proposed scheme focuses on how to combine the multicast service with the existing fast handover procedure for a fast and reliable multicast packet delivery. In the proposed scheme, we consider the following three cases: Path Extension method, Bi-Directional Tunneling, and Remote Subscription. The fourth case, in which NAR has already joined the tree, is not considered, since it is too much trivial.
In the tree joining case, we consider the following two scenarios: (a) short tree join, in which the tree join process is completed before NAR receive the FBACK message from PAR, and (b) long tree join, in which the tree join is completed after NAR receives the FBACK message. In the first case (short tree join), the PAR does not need to forward the data packets to NAR, and instead NAR will receive the multicast data packets directly from the multicast tree, and then send the HO COMPLETE message to PAR. On the other hand, in the second case, the NAR will receive some of multicast data packets from PAR, until the tree join process is completed.

Figure 2 shows the basic operation of the proposed FMIPv6-FTJ scheme.

Upon receiving an indication from a wireless link-layer trigger, MN initiates the handover by sending a message RtSolPr that contains both the FBU option and the multicast address. After receiving the RtSolPr message, PAR sends the PrRtAdv message to MN. At the same time, PAR will send the HI message to the NAR.

When receiving the HI message, the NAR will immediately respond with the HACK message to PAR, and then begin the tree join to the RP by sending the PIM JOIN message. (FMIPv6-FTJ with Remote Subscription): in which the tree join is completed earlier (i.e., before the NAR receives the FBACK message from PAR). In this case, the NAR will receive the PIM JOIN-ACK message from the upstream RP, and then send the HO-COMPLETE message to the PAR. Accordingly, the PAR will not perform the packet forwarding to NAR.
To support the proposed FMIPv6-FTJ scheme, we suggest to use the three modified messages. The existing RtSolPr and FBU messages are merged into a single RtSolPr message that contains the FBU option and multicast address. Note that the other two messages, HI and HACK, are changed to include the MN ID (Home Address of MN) and the multicast address.

4. Conclusions

This internet draft describes a fast tree join for seamless multicast handover in the FMIPv6-based wireless/mobile networks. In the existing scheme, there may be a buffer overflow problem during the

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Due to this buffer overflow problem, many packets may be lost. To overcome this drawback, the proposed scheme will begin to join the multicast tree, as soon as the handover is detected.

5. References

5.1. Normative References


5.2. Informative References


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