MULTIMOB Group
Internet-Draft
Intended status: Informational
Expires: July 12, 2012

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January 9, 2012

Context Transfer Protocol Extension for Multicast
draft-vonhugo-multimob-cxtp-extension-01

Abstract

This document describes an extension of the Context Transfer Protocol (CXTP) to support seamless IP multicast services with Proxy Mobile IPv6 (PMIPv6).

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Table of Contents

1. Introduction

This document describes an extension of the Context Transfer Protocol (CXTP) [9] to provide seamless handover for multicast communications operated with Proxy Mobile IPv6 (PMIPv6) [2]. When a mobile node receiving multicast data detaches from the current MAG and attaches to a new MAG, the node should be able to continuously receive the multicast data through the new MAG just after the node completed handover without any MLD signaling on the new wireless link. This procedure is multicast context transfer that provides multicast session continuity and avoids extra packet loss and session disruption. Multicast context transfer will be the required function to support seamless handover, while for its effective procedure, interaction with multicast communication protocols should be taken into account.

The Context Transfer Protocol (CXTP) specification [9] describes the mechanism that allows better support for minimizing service disruption during handover. In this document, CXTP is extended for the multicast context transfer protocol in PMIPv6. "Multicast-Context Transfer Data (M-CTD)" is defined for transferring multicast membership state from a previously attached MAG (p-MAG) to a newly attached MAG (n-MAG) for PMIPv6. The context transfer is either started from the n-MAG on its own after attachment of the mobile node or initiated by the p-MAG after being informed by the access network of the planned handover. For data exchange between p-MAG and n-MAG a dedicated tunnel is assumed to be in place. Whether this p-MAG - n-MAG tunnel has already been set up in advance or will be initiated during handover by either p-MAG or n-MAG will impact the overall session delay. Details of this set-up procedure are out of scope of this document.

An approach to apply CXTP to multicast for client-based mobile IPv6 had been proposed in [13].

2. Conventions and Terminology

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 [1].

The following terms used in this document are to be interpreted as defined in the Proxy Mobile IPv6 specification [2]; Mobile Access Gateway (MAG), Local Mobility Anchor (LMA), Mobile Node (MN), Proxy Mobile IPv6 Domain (PMIPv6-Domain), LMA Address (LMAA), Proxy Care-of Address (Proxy-CoA), Mobile Node's Home Network Prefix (MN-HNP), Mobile Node Identifier (MN-Identifier), Proxy Binding Update (PBU), and Proxy Binding Acknowledgement (PBA).

3. Handover Process

MAG is responsible for detecting the mobile node's movements to and from the access link and for initiating binding registrations to the mobile node's LMA. MAG tracks the mobile node's movements to and from the access link and performs signaling of the status to the mobile node's LMA. In PMIPv6, it SHOULD NOT be required for mobile nodes to initiate re-subscription to multicast channels, and MAG SHOULD keep multicast membership state for mobile nodes even if they attach a different MAG in PMIPv6-Domain.

For multicast context transfer, an IGMP/MLD-based explicit membership tracking function [11] MUST be enabled on MAG (whether the MAG behaves as a router or proxy). The explicit tracking function enables a router to keep track of downstream multicast membership state created by downstream hosts attached on the router's link. When a mobile node attaches to a new network, thanks to the explicit tracking function, the p-MAG extracts the mobile node's multicast membership state from complete multicast membersip state the p-MAG has maintained and transmits it to the n-MAG.

3.1. Multicast Context Transfer Data Format

Multicast Context Transfer Data (M-CTD) is a message used with CXTP to transfer multicast membership state from p-MAG to n-MAG. The following information is included in M-CTD to recognize mobile node's membership state.

1. Receiver address - indicates the address of the MN sending the Current-State Report.

2. Filter mode - indicates either INCLUDE or EXCLUDE as defined in [4].

3. Source addresses and multicast addresses - indicates the address pairs the MN has joined.

The M-CTD message MUST contain the 'A' bit set as defined for the CTD message format in [9] for to initiate the transmission of a reply message by the new MAG.

The following information included in a reply to M-CTD (similar to the CTDR message defined in [9]) is used to request the old MAG to store still incoming multicast data, to forward them to the new MAG, and finally to leave the multicast group after successful handover from n-MAG to p-MAG.

1. Receiver address - indicates the address of the MN sending the Current-State Report.

2. Flag indicating the p-MAG to start (B) buffering the received multicast data (in case the new connection is not yet fully set up), to forward (F) the buffered data after successful handover, or to leave (L) the multicast groups unless there are still other active subscriptions for the corresponding groups on the p-MAG.

3. Source addresses and multicast addresses - indicates the address pairs the MN has joined.

The M-CTDR message MUST contain the 'S' bit set as defined for the CTD message format in [9] for to indicate the successful reception

of context data at the new MAG.

The explicit tracking function [11] does not maintain information of an (S,G) join request with EXCLUDE filter mode. Therefore, when the "Filter mode" for a multicast session is EXCLUDE, "Source address" for the session MUST be set "Null".

3.2. Multicast Context Transfer with MLD Proxy

This section describes the case that MAG operates as an MLD proxy, as defined in [6] and specified in the base MultiMob solution [10].

The MLD listener handover with CXTP and MLD proxy shown in Figure 1 is defined as follows.

1. After attaching a new MAG, a mobile node sends a Router Solicitation (RS) as specified in [7]. As the MN shall remain unaware of any change in connectivity the n-MAG has to identify the p-MAG address during proxy binding registration process with the mobile node's LMA. n-MAG then sends a request for context transfer (CT-Req) to the p-MAG as defined in [9]. Since the MN cannot initiate the related Context Transfer Activate Request (CTAR) message that may be sent by the LMA. In case the mobile node has the capability and the chance to signal to the p-MAG the link status and the potential new MAG address (e.g. as is specified in terms of Event Services by [8]) the p-MAG will send a CTAR message to n-MAG on behalf of the mobile node. Alternatively the p-MAG or the n-MAG may have information on potential MAGs in their vicinity to which such a CTAR or CT-Req message may be multicasted.

2. p-MAG provides together with the other feature data the multicast states corresponding to the moving MN-Identifier to n-MAG. p-MAG utilizes a context transfer protocol to deliver MN's Policy Profile to n-MAG, and sends Multicast Context Transfer Data (M-CTD) (defined in Section 3.1) to n-MAG.

3. If there are multicast channels the MN has subscribed but the n-MAG has not yet subscribed, n-MAG subscribes via sending

(potentially aggregated) MLD [4][5] Membership Report messages (i.e. Join) to the corresponding LMA.

4. n-MAG requests from p-MAG to store still incoming multicast data for transfer to MN after successful handover completion. For this purpose a newly defined B-flag in the Multicast Context Transfer Response message is sent from n-MAG to p-MAG, denoted as M-CTDR(B).

5. After successful completion of MN attachment to n-MAG the forwarding of the stored Multicast data from p-MAG to n-MAG is initiated via sending a Multicast Context Transfer Response message with a newly defined F-flag from n-MAG to p-MAG, denoted as M-CTDR(F).

6. LMA forwards requested multicast data to the n-MAG which subsequently delivers them to MN.

7. n-MAG may request from p-MAG to leave those multicast groups it had subscribed to on behalf of the MN where MN had been the last member. This is done via sending a Multicast Context Transfer Response message from n-MAG to p-MAG with a newly defined L-flag set, denoted as M-CTDR(L).

MN p-MAG n-MAG LMA

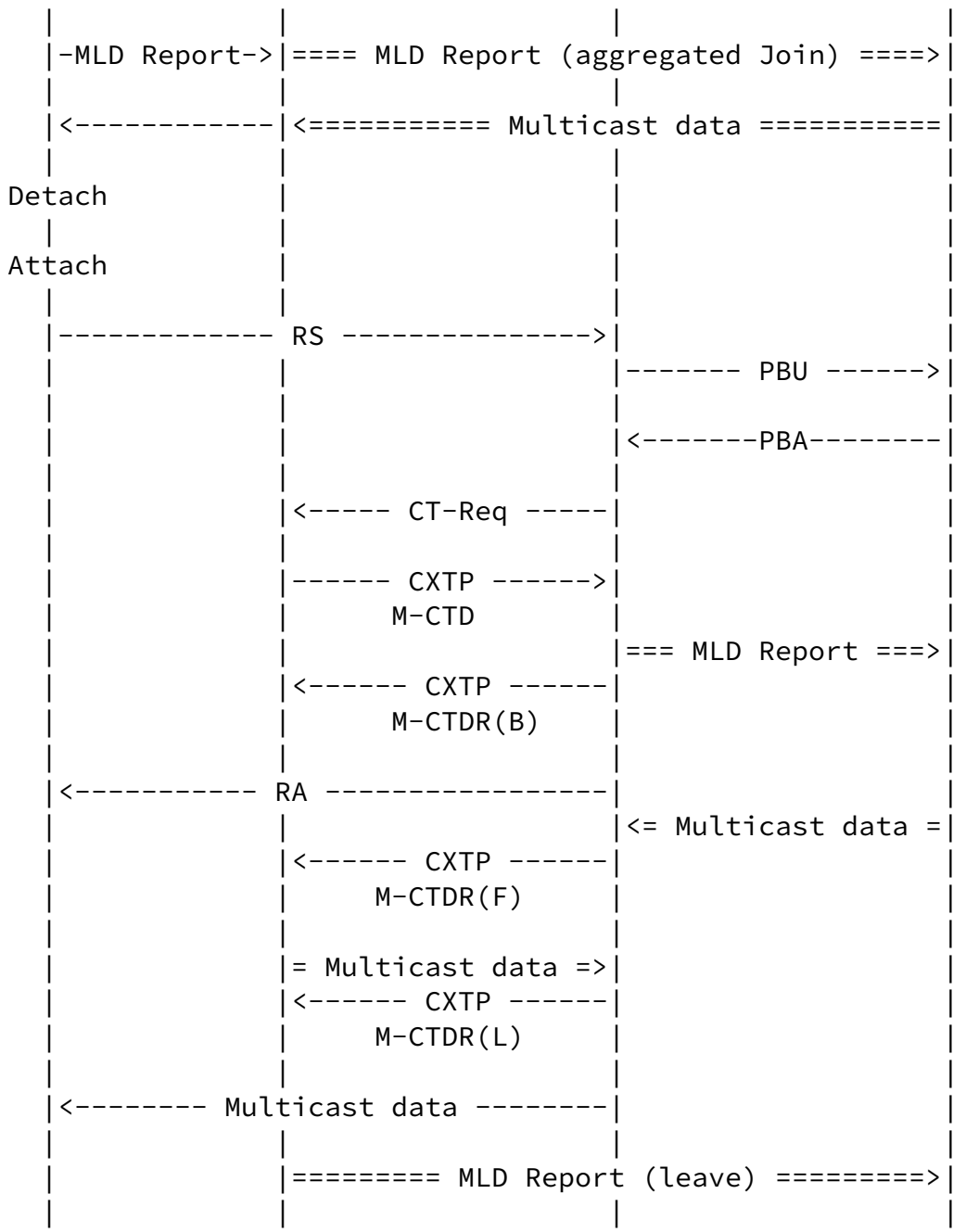

Figure 1: MLD listener handover with CXTP and MLD proxy

After MN attaches to n-MAG, the forwarded multicast data from p-MAG will be delivered to the MN immediately. Afterwards the current multicast data are delivered as received from LMA and the MN's multicast membership state at the p-MAG is cancelled.

3.3. Multicast Context Transfer with PIM-SM

This section describes the case that MAG operates as a PIM-SM [3] router, as described in a proposed solution [12].

The MLD listener handover with CXTP and PIM-SM shown in Figure 2 is defined as follows.

1. The first and second procedures are the same ones as described in Section 3.2.

2. If there are multicast channels the MN has subscribed but the n-MAG has not yet subscribed, n-MAG joins the multicast tree via sending PIM Join messages to the upstream router (Figure 2 shows the example that the upstream router is the corresponding LMA).

3. The remaining steps for completion of the context transfer are the same ones as described in Section 3.2 with the only exception being that p-MAG sends a PIM Prune message to LMA instead of a MLD Report (leave) message if there are no attached mobile nodes listening the multicast channels.

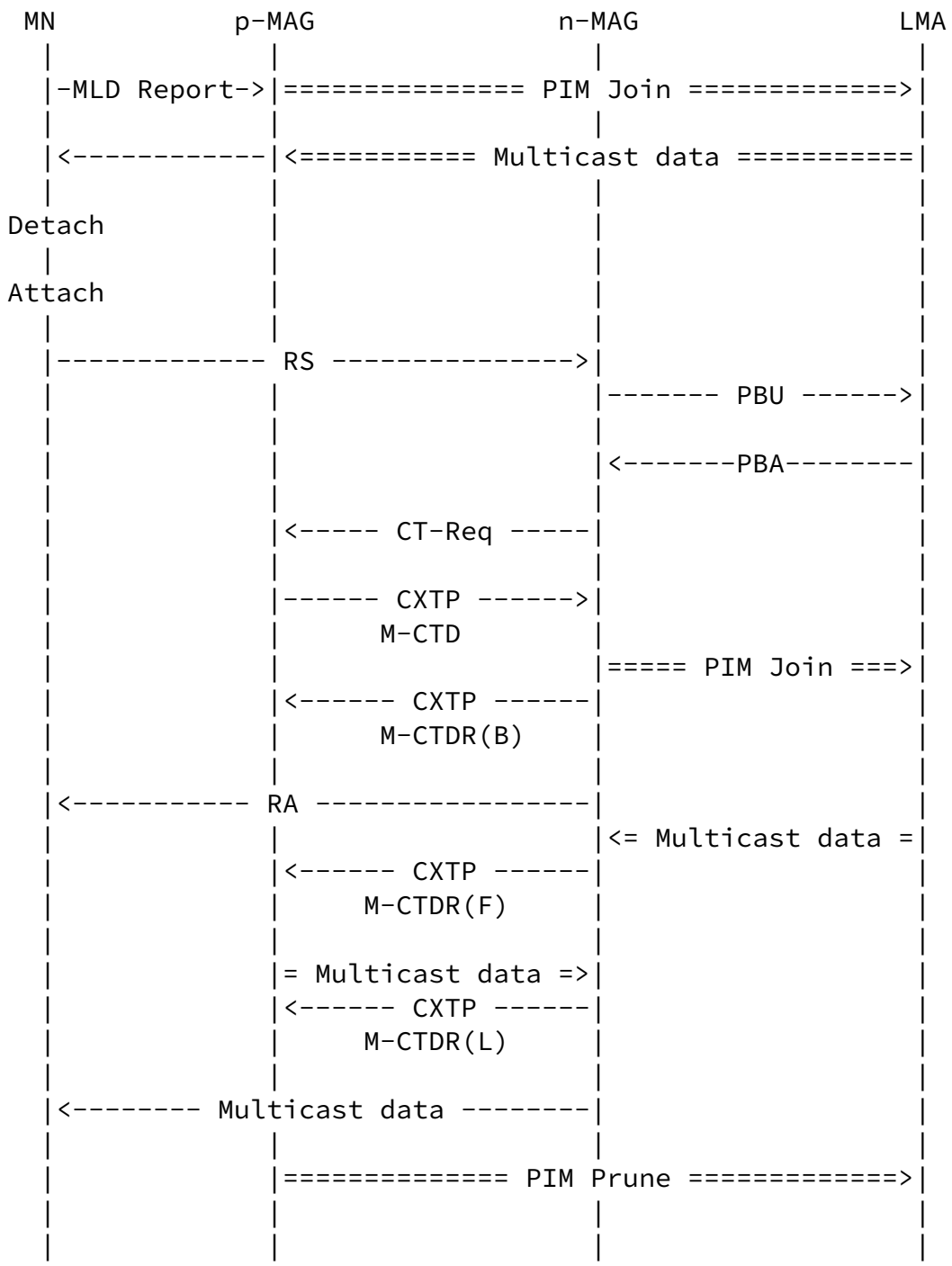
MN
p-MAG
n-MAG
LMA
-MLD Report->
PIM Join
<-
Multicast data
Detach
Attach
RS
PBU
PBA
CT-Req
CXTP
M-CTD
PIM Join
M-CTDR(B)
RA
Multicast data
M-CTDR(F)
Multicast data
M-CTDR(L)
Multicast data
PIM Prune

Figure 2: MLD listener handover with CXTP and PIM-SM

4. IANA Considerations

TBD.

5. Security Considerations

TBD.

6. Acknowledgements

Many of the specifications described in this document are discussed and provided by the multimob mailing-list. Detailed comments by Luis Miguel Contreras Murillo are gratefully acknowledged.

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