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INFORMATION TECHNOLOGY – MOBILE MULTICAST COMMUNICATIONS: PROTOCOL OVER NATIVE IP MULTICAST NETWORKS

SUMMARY

This Recommendation | International Standard describes the Mobile Multicast Control Protocol (MMCP) for mobile multicast communications over native IP multicast networks. This Recommendation | International Standard describes the specification of the MMCP protocol, which includes design considerations, protocol operations and packet format.

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KEYWORDS

Mobile Multicast Communication, IP Multicasting, Mobile Multicast Control Protocol

FOREWORD

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

ISO/IEC 24793 consists of the following parts, under the general title of Information Technology — Mobile Multicast Communications:

- Part 1: Framework (ITU-T X.604 | ISO/IEC 24793-1, MMC-1)
- Part 2: Protocol over Native IP Multicast Networks (ITU-T X.604.1 | ISO/IEC 24793-2, MMC-2)
- Part 3: Protocol over Overlay Multicast Networks (ITU-T X.604.2 | ISO/IEC 24793-3, MMC-3)

1. SCOPE

This Recommendation | International Standard describes the specification of Mobile Multicast Control Protocol (MMCP) over native IP multicast networks for mobile multicast communications. The MMCP can be used to support a variety of multimedia multicasting services in the IP-based wireless mobile networks. The MMC is targeted at the real-time one-to-many multicast services and applications over mobile communications networks. This Recommendation | International Standard describes the procedures and packet formats of the MMCP protocol.

2. NORMATIVE REFERENCES

- a) ITU-T Recommendation X.604 (working in progress) | ISO/IEC 24793-1 (working in progress), Information Technology — Mobile Multicast Communications: Framework
- b) IETF RFC 2236 (1997), Internet Group Management Protocol Version 2 (IGMPv2), Proposed Standard
- c) IETF RFC 2710 (1999), Multicast Listener Discovery (MLD) for IPv6, Proposed Standard

3. DEFINITIONS

This Recommendation | International Standard uses the terms and definitions that are defined in the MMC framework, ITU-T Recommendation X.604 | ISO/IEC 24793-1.

4. ABBREVIATIONS

AAA	Authentication, Authorization, and Accounting
ACK	Acknowledgement
ASR	Aggregation Status Report
CTT	Context Transfer Time
HCT	Handover Context Transfer
HIC	Handover Initiation Confirm
HIR	Handover Initiation Request
HIT	Handover Initiation Time
HTA	Handover Transfer ACK
ID	Identifier
IGMP	Internet Group Management Protocol
JWT	Join Waiting Time
LJC	Local Join Confirm
LJR	Local Join Request
LMC	Local Mobility Controller
MCS	Multicast Contents Server
MLD	Multicast Listener Discovery
MMC	Mobile Multicast Communications
MMCF	MMC Framework
MMCP	Mobile Multicast Control Protocol

MN	Mobile Node
MR	Multicast Router
PoA	Point of Attachment
QoS	Quality of Services
SJC	Session Join Confirm
SJR	Session Join Request
SM	Session Manager
SPT	Status Probe Time
SRT	Status Report Time
TLV	Type-Length-Value
ULC	User Leave Confirm
ULR	User Leave Request
USP	User Status Probe
USR	User Status Report

5. OVERVIEW

The MMCP provides the control functionality for multicast data channels: Session Join, Status Monitoring and Handover Support. A multicast data session consists of an MCS (sender) and many MNs (receivers). The MCS will transmit multicast data packets to many prospective receivers, according to a pre-determined program schedule. To receive the multicast data in the network, an MN will first perform the IGMP/MLD operations with the corresponding access router in the IP subnet. The MMCP can be used for control of multicast sessions together with any multicast data channels. The details of multicast data transport mechanisms are outside the scope of MMCP.

For Session Join, a prospective MN shall send a session join request message to the MMCP Session Manager (SM). The join request message shall include the following information: Session ID and MN ID. MN ID is an identifier allocated to the MN, which may be given a priori by a services provider. On receipt of the session join request message, SM shall respond to the MN with a session join confirm message. The responding confirmation message will indicate whether the join request is accepted or not. In case that a Local Mobility Controller (LMC) is allocated to the MN, the session join confirm message will also contain the contact information of the associated LMC. In case that an LMC is assigned to the MN, after receiving the join confirm message, the MN shall also join the designated LMC by sending a local join request message. On receipt of the local join request message, the LMC shall respond to the MN with a local join confirm message.

For User Leave, during the multicast session, an MN may want to leave the session. For this purpose, the MN may send a user leave request message to the LMC (in case that an LMC is assigned to MN) or SM (in case that no LMC is assigned to MN). The LMC (or SM) may respond to the MN with the user leave confirm message. It is noted that this user leave operation is optional. That is, a certain MN may leave the session without any notice.

Status Monitoring is used by SM to monitor the dynamics for group/session membership and the status of multicast data channel (e.g., statistics such as total number of packets received during the session). For status monitoring, each MN shall send a periodic status report message to its upstream LMC or SM (in case that no LMC is assigned to MN). Each LMC will aggregate the status information for its downstream MNs, and send a periodic aggregate status report message to SM. In the meantime, the status report messages may be lost in the network. In this case, the upstream LMC or SM may solicit a status report message to the concerned MN or LMC by sending a status probe message.

For Handover Support, after movement detection, MN begins the handover operations by sending a handover request message to the current LMC. The handover request message shall include the information about the new point of attachment (PoA) such as the link-layer MAC address or ID of the PoA. On receipt of a handover request message from MN, the LMC will first identify which subnet the MN is going to move into. The current LMC can identify the new

LMC by using the address of ID of the new PoA that is indicated in the handover request message. For handover support, the current LMC shall send a handover context transfer message to the new LMC. Then, the new LMC will perform the IGMP/MLD join operation to the new MR, instead of the MN. This will ensure that the MN can receive the multicast data packets in the newly visited subnet as fast as possible. After that, the new LMC will respond to the current LMC with a handover transfer ACK message. In turn, the current LMC will send a handover confirm message to the MN. This will complete the handover operation of MMCP. After further movement, MN will complete the establishment of a new L2 and L3 connection (for a new IP address of MN). Then the MN performs the local join operations with the new LMC.

6. CONSIDERATIONS

6.1 PROTOCOL MODEL

The MMCP is based on the Mobile Multicast Communications Framework (MMCF) specified in the ITU-T Recommendation X.604 | ISO/IEC 24793-1. The MMCP is designed to support one-to-many real-time multicast applications running over IP multicast-capable wireless/mobile networks. MMCP operates over IPv4/IPv6 networks with the IP multicast forwarding capability such as the IGMP/MLD and IP multicast routing protocols. As a control protocol, MMCP provides a mobile user with the session join and user leave, status monitoring, and handover support for multicast data channels.

The MMCP is a control protocol that is used for control of the mobile multicast sessions over native IP multicast mobile/wireless networks. It is assumed that the multicast data channels are provided with the help of the UDP/IP multicasting in the network. That is, the MMCP is independent of multicast data channels, as depicted in the following figure.

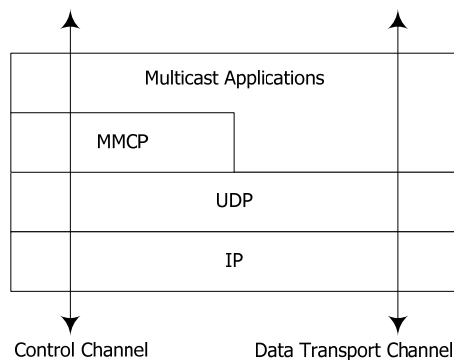


Figure 1 – Protocol Model

A multicast data channel can use the MMCP protocol for control of multicast sessions. For this purpose, MMCP provides a set of application programming interfaces (APIs) for any multicast data channels/applications. In the protocol stack point of view, an MMCP message is encapsulated into the UDP datagram.

6.2 PROTOCOL ENTITIES

This clause describes the protocol entities associated with MMCP.

6.2.1 MOBILE NODE (MN)

An MN represents an end user that receives multicast data transport services from multicast contents server. To receive the multicast data from the network, MN should be equipped with the multicast capability such as the IGMP/MLD protocol. MN is also required for the MMCP functionality. With the help of MMCP, an MN can benefit from the control services such as session join, status monitoring, and handover support.

6.2.2 MULTICAST CONTENTS SERVER (MCS)

In MMCP, an MCS represents the sender of the multicast data channel/session. MCS will continue to transmit the multicast data streams over the network, and a lot of MNs will receive the data packets after session join. MCS is associated with only the multicast data channel only rather than the MMCP control channel. MCS could exchange some session-related information with the MMCP session manager, possibly using a dedicated communication channel, which is outside the scope of this specification.

6.2.3 SESSION MANAGER (SM)

SM is responsible for overall operations of MMCP. In Session Join, SM will respond to the join request of a promising MN. For authentication, SM may contact with an AAA-related database or user profile that has been preconfigured by services provider, which is outside the scope of MMCP. In Status Monitoring, SM will monitor the overall status of the membership and session for all of the MNs. For this purpose, each MN will send a periodic control messages to SM, possibly by way of a local mobility controller. The SM may be implemented with the MCS on the same system, which is an implementation issue.

6.2.4 LOCAL MOBILITY CONTROLLER (LMC)

LMC is used to locally control the movement of MN. In the mobile wireless networks, when an MN moves into the other network region during the multicast session, the handover support is required for seamless multicast services. The LMC is used to support the seamless handover for MN in the wireless/mobile networks.

For handover support, the movement of MN will be informed to the associated LMC. To provide the seamless services, an LMC may interact with other LMC that is in the network newly visited by MN. With the help of the LMC, an MN can be given seamless multicast services against handover. LMC is also used for status monitoring of MNs. Each MN will send a periodic message to LMC, and the LMC aggregates the status of its downstream MNs and forwards the aggregated status information to SM. It is noted that an LMC acts as a network agent for MNs in MMCP.

It is assumed that a set of LMCs have been deployed in the wireless networks by the services provider.