INTERNATIONAL STANDARD

ISO/IEC 16512-1

Second edition
2016-04-01

Information technology — Relayed Multicast Control Protocol (RMCP) — Framework

Technologies de l'information -- Protocole de multidiffusion relayé (RMCP) — Cadre général

Reference number
ISO/IEC 16512-1:2016(E)

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Published in Switzerland

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword – Supplementary information.

This second edition cancels and replaces firs edition of ISO/IEC 16512-1:2005 which has been technically revised.

ISO/IEC 16512-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in collaboration with ITU-T. The identical text is published as ITU-T X.603 (03/2012).

ISO/IEC 16512 consists of the following parts, under the general title *Information technology — Relayed multicast protocol*:

— *Part 1: Framework*

— *Part 2: Specification for simplex group applications*

CONTENTS

Introduction

This Recommendation | International Standard specifies the relayed multicast protocol (RMCP) used for realizing relayed multicast. Relayed multicast, also known as an overlay multicast or an application-layer multicast, is a data-delivery scheme for group communications applications over an IP-based network environment. RMCP employs intermediate multicast agents for relaying application data from one or more senders to many receivers.

The design of RMCP has been motivated from the following observations:

In the marketplace, diverse group applications and services have been provisioned commercially all over the world. Some of the examples include Internet TV, remote education, real-time media streaming applications, live broadcasting of special events such as the Victoria's Secret Fashion Show, stock-tickers, etc.

At present, most of the group applications mentioned above use a replicated IP unicast method to realize group services. As a result, those applications have scalability problems due to the limitation in supporting a number of simultaneous users. In terms of a business model, it would mean less revenue or profit.

IP multicast has been known as an effective transport technology for providing group communication services. Nevertheless, the IP multicast has not been deployed widely over the Internet due to several reasons, including the following:

- high deployment cost along with an uncertainty of return-on-investment (ROI)
- IP multicast alone cannot support all kinds of group applications.

Network services such as group file transfer or network games, need a reliable multicast transport mechanism. However, even current reliable multicast transport mechanisms still have unresolved problems including scalability, flow control, congestion control, etc. Until an appropriate multicast transport mechanism is laid down, group communication applications requiring reliable data transfer will continue to depend on the server-based replicated unicast method.

Although IP multicast is not deployed globally, various local networks have already been equipped with IP multicast capability. For example, Ethernet-based LANs and private networks, such as corporate and campus networks, substantially provide the multicast transport capability within their local subnet or administrative domains.

Recognizing these observations, there is a crucial need to develop an alternative group delivery scheme. RMCP is one such scheme to realize group delivery over the IP-based network. RMCP utilizes existing unicast, multicast, and/or multicast tunnelling schemes. In addition, RMCP is designed in separate forms to support any kind of group service type. RMCP is expected to provide a substantial solution for group services over the IP-based network.

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Information technology – Relayed multicast protocol: Framework

1 Scope

Relayed multicast protocol (RMCP) is a protocol which is used to realize a relayed multicast data transport scheme. Different from the conventional IP multicast, RMCP can configure a relayed multicast path that multicast traffic flows by using intermediate end-hosts. RMCP can be applied to the current unicast based IP network where IP multicast is not fully deployed.

This Recommendation | International Standard addresses the basic concepts needed to specify RMCP for relayed multicast. It defines the related terminology and proposes a framework for the future development of subsequent protocols. The framework covers network topology including network entities and the relationship among them, service scenarios, basic operations, and message format.

2 Normative references

None.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation | International Standard

For the purpose of this Recommendation | International Standard the following definitions apply:

3.2.1 child multicast agent (CMA): A next downstream multicast agent (MA) in the relayed multicast protocol (RMCP) data delivery path.

3.2.2 IP multicast: Realizes a multicast scheme in the IP network with the help of multicast-enabled IP routers.

3.2.3 multicast: A data delivery scheme where the same data unit is transmitted from a single source to multiple destinations in a single invocation of service.

3.2.4 multicast agent (MA): An intermediate node which relays group application data.

3.2.5 N-plex: Wherein anyone can send something, and, if someone does so, all others may receive it.

3.2.6 parent multicast agent (PMA): A next upstream multicast agent (MA) in the relayed multicast protocol (RMCP) data delivery path.

3.2.7 relayed multicast: A multicast data delivery scheme that can be used in unicast environments.

3.2.8 receiver multicast agent (RMA): A multicast agent (MA) other than sender multicast agent (SMA).

3.2.9 relayed multicast protocol (RMCP): A protocol to realize the relayed multicast scheme using end hosts.

3.2.10 relayed multicast protocol (RMCP) session: A set of multicast agents (MAs) which configures the data delivery path using RMCP.

3.2.11 session identification (SID): Corresponds to group name and identifies relayed multicast protocol (RMCP) session uniquely.

3.2.12 session manager (SM): A relayed multicast protocol (RMCP) entity that is responsible for the overall RMCP operations.

3.2.13 sender multicast agent (SMA): A multicast agent (MA) attached to a sender in the same system or local network.

3.2.14 simplex: Wherein only one sender is send-only and all others are receive-only.

4 Abbreviations

For the purposes of this Recommendation | International Standard, the following abbreviations apply:

CMA Child Multicast Agent

IPC Inter-Process Communication

IPIP IP in IP encapsulation

MA Multicast Agent

PMA Parent Multicast Agent

RMA Receiver Multicast Agent

RMCP Relayed Multicast Protocol

RMT Reliable Multicast Transport

SID Session ID

SM Session Manager

SMA Sender Multicast Agent

T/TCP TCP extensions to Transactions

TCP Transmission Control Protocol

TP Transport Protocol

UDP User Datagram Protocol

5 Conventions

None.

6 Framework of RMCP

6.1 Introduction

Relayed multicast protocol (RMCP) is an application-level multicast protocol. It constructs and manages a relayed multicast network to support the group communication services over the current unicast-based IP network. After a series of RMCP control connections are established, a multicast data delivery path is constructed by using multiple multicast agents (MAs). Along the delivery path, real-time or reliable data transport channels are inter-connected between upstream and downstream MAs. Only after the data delivery path and data channel are established, group communication applications can work as in the native IP multicast network.

RMCP aims to support various kinds of group-based applications and services. Table 1 categorizes the group communication services with types of communications and characteristics of data delivery.

Table 1 – Considerable group communication services

Characteristics / Type of communications	Real-time data	Reliable data
Simplex	Internet live TV, Internet live banner	Stock-ticker, file dissemination, software live update
N-plex	Videoconference, inter-domain multicast proxy	Distributed virtual environment, network game, data mirroring and caching

6.2 Basic concept of RMCP

Each RMCP session configures relayed multicast data delivery model with the following entities as shown in Figure 1:

a) One session manager (SM);

b) Sender multicast agent (SMA) per sender application;

c) One or more receiver multicast agents (RMAs);

d) Group communication applications sending or receiving group data.

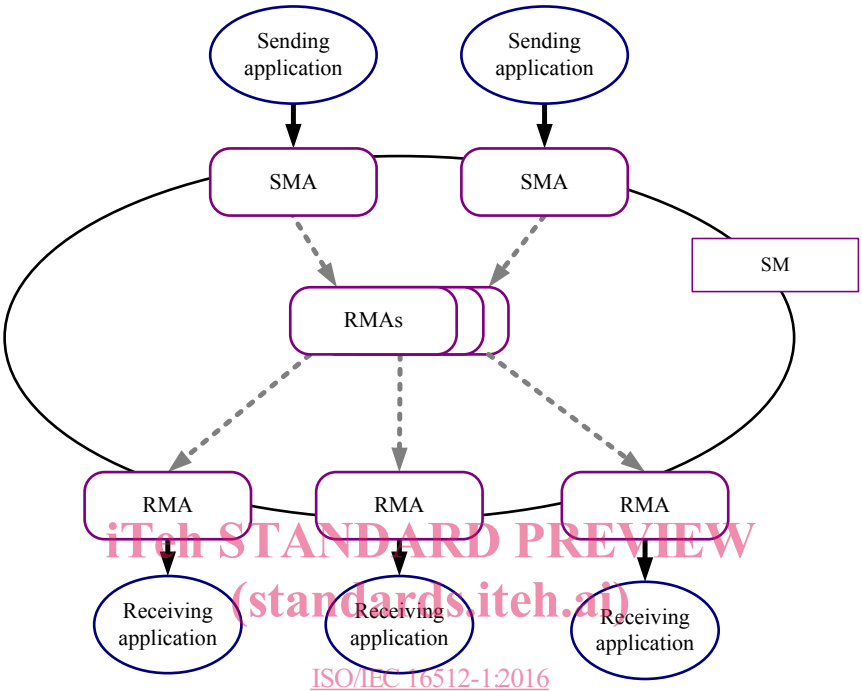

Figure 1 – RMCP entities

The SM is involved in session configuration and maintenance. A single SM can handle one or multiple sessions, simultaneously. Since the SM does not participate in data delivery, it has RMCP control module only. Figure 2 shows the protocol stack of SM.

RMCP control module
Transport protocol for message delivery
IP (unicast)

Figure 2 – Protocol stack of SM

A session manager (SM) can provide the following functionalities:

a) Session initiation;

b) Session termination;

c) Session membership management;

d) Session status monitoring and management.

The MA, which covers both SMA and RMA, constructs a relayed multicast data delivery path and forwards data along the constructed path from SMA to RMA(s). An MA consists of an RMCP control module and a data module. The main function of the control module is to establish a relayed data delivery path, and the data module is to deliver data along the constructed delivery path. Figure 3 shows the protocol stacks of the MA.

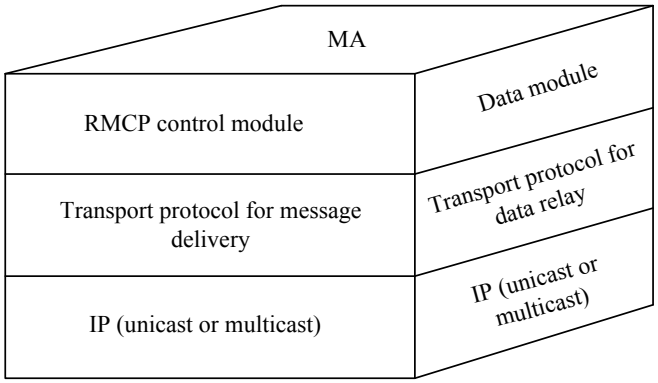

Figure 3 – Protocol stack of the MA

The RMCP control module exchanges RMCP messages with RMCP control modules in other RMCP entities. It performs the following functions:

a) Session join;
b) Session leave;
c) Session maintenance;
d) Session status report.

The message flows among RMCP control modules are shown in Figure 4. As shown in the figure, an MA can be implemented in the same system with the application or in the same local network such as Ethernet-LAN. To deliver the RMCP messages, any type of reliable transport protocols can be used such as TCP. The RMCP control module can also use multicast transport protocols for delivering RMCP messages in the multicast network. In this case, the User Datagram Protocol (UDP) can be used as a transport protocol.

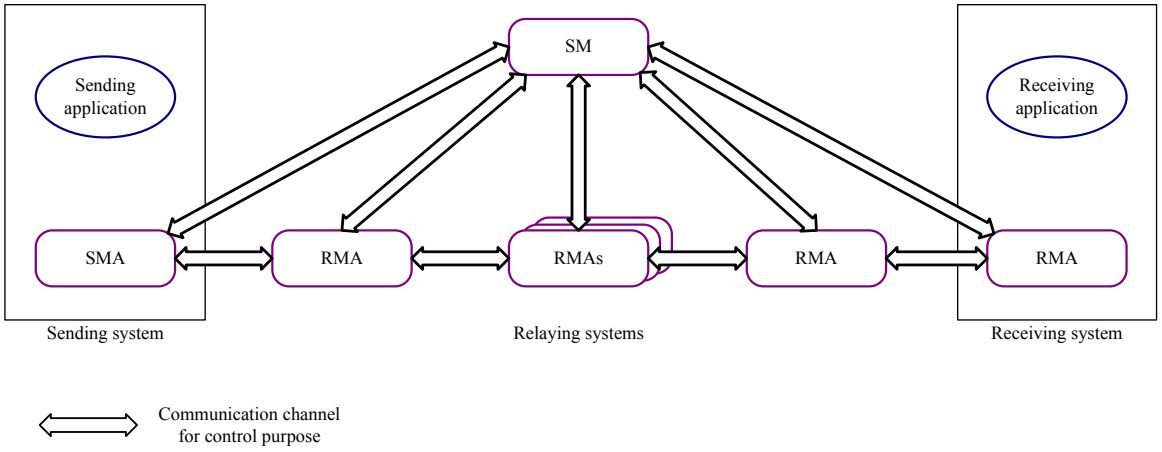

Figure 4 – RMCP control model

The data module relays data along the relayed multicast data delivery path constructed by the RMCP control module as shown in Figure 5. The relayed multicast data delivery path consists of one or more senders, a single SMA per sender, one or more RMAs and receivers. Any kind of transport protocols can be used to transport data.

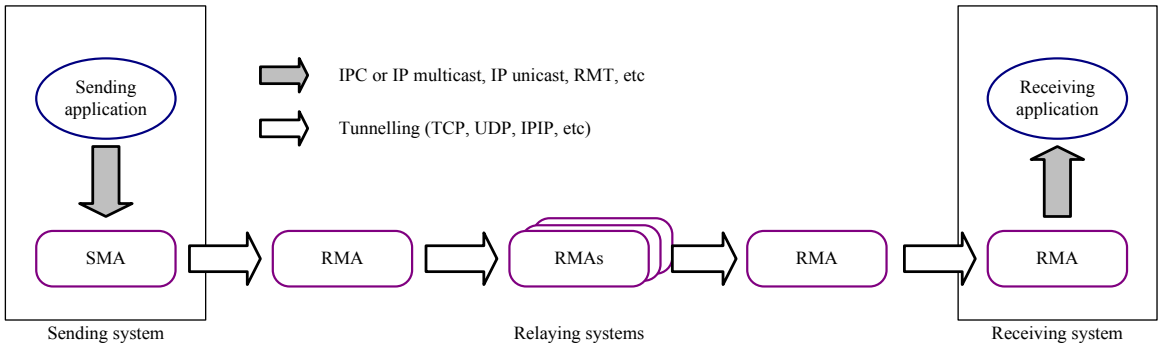

Figure 5 – RMCP data transport model

According to the direction of relaying data, an MA can act as an SMA or as an RMA. When acting as an RMA, the MA receives data from its parent multicast agent (PMA) and forwards the data to its child multicast agent(s) (CMA(s)) and data receiver(s), i.e., receiving application(s). SMA receives data from the data sender, i.e., sending application, and forwards the data to its CMA(s). The number of SMAs depends on the number of data senders.

6.3 RMCP data delivery model

RMCP can support both simplex service, where there is one sender in each session, and N-plex service, where multiple senders can be in each session.

6.3.1 Simplex delivery model for real-time services

Simplex real-time broadcasting services such as Internet live TV and software banner require a real-time data delivery path from one sender to multiple receivers. The most optimized data delivery path would be a per-source relayed multicast tree where a unidirectional real-time channel is established. Figure 6 shows one of the possible relayed multicast trees configured by the RMCP for simplex real-time applications.

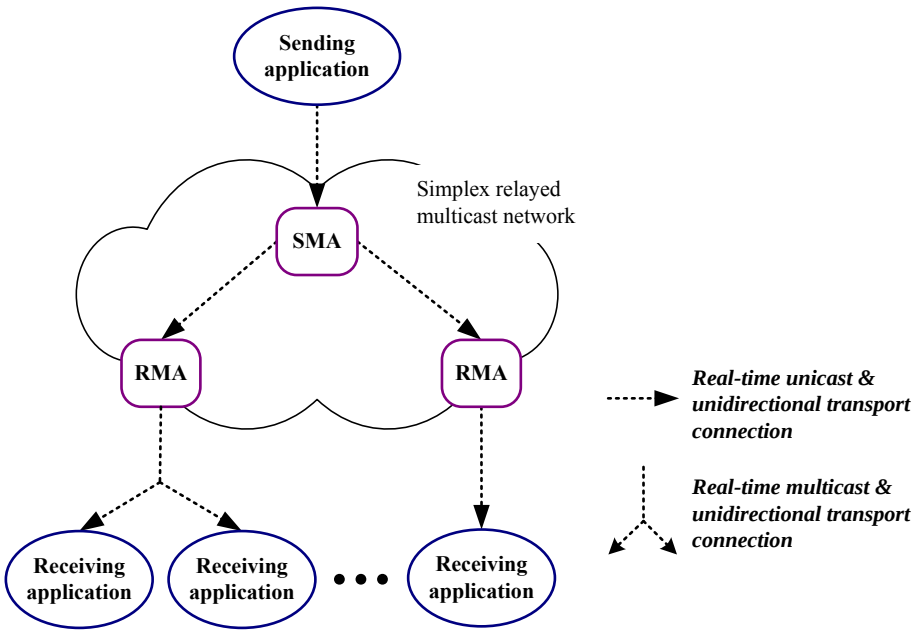

Figure 6 – Simplex real-time data delivery model