Multicast Acquisition Report Block Type for RTCP XR
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Abstract

In most RTP-based multicast applications, the RTP source sends interrelated data. Due to this interdependency, randomly joining RTP receivers usually cannot start consuming the multicast data right after they join the session. Thus, they often experience a random acquisition delay. One approach to reduce this delay is to use an auxiliary unicast RTP session with a retransmission server to receive a burst stream that facilitates rapid acquisition of the multicast stream. An RTP receiver may use this approach (or any other approach) to achieve rapid acquisition. Yet, due to various factors, performance of the rapid acquisition methods usually varies. Furthermore, in some cases the RTP receiver may (or may have to) do a simple multicast join. For quality reporting, monitoring and diagnostics purposes, it is important to collect detailed information from the RTP receivers about their acquisition and presentation experiences. This document addresses this issue by defining a new report block type, called Multicast Acquisition (MA) Report Block, within the framework of RTP Control Protocol (RTCP) Extended Reports (XR). This document also defines the necessary signaling of the new MA report block type in the Session Description Protocol (SDP).
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1. Introduction

RTP Control Protocol (RTCP) is the out-of-band control protocol for the applications that are using the Real-time Transport Protocol (RTP) for media transport [RFC3550]. In addition to providing minimal control functionality to RTP entities, RTCP also enables a basic level monitoring of RTP sessions via sender and receiver reports. More statistically detailed monitoring as well as application-specific monitoring is usually achieved through the RTCP Extended Reports (XR) [RFC3611].

In most RTP-based multicast applications such as the ones carrying video content, the RTP source sends inter-related data. Consequently, the RTP application may not be able to decode and present the data in an RTP packet before decoding one or more earlier RTP packets and/or before acquiring some Reference Information about the content itself. Thus, RTP receivers that are randomly joining a multicast session often experience a random acquisition delay. In order to reduce this delay, [I-D.ietf-avt-rapid-acquisition-for-rtp] proposes an approach where an auxiliary unicast RTP session is established between a retransmission server and the joining RTP receiver. Over this unicast RTP session, the retransmission server provides the Reference Information, which is all the information the RTP receiver needs to rapidly acquire the multicast stream. However, depending on the variability in the Source Filtering Group Management Protocol (SFGMP) processing times, availability of network resources for rapid acquisition and nature of the RTP data, not all RTP receivers can acquire the multicast stream in the same amount of time. The performance of rapid acquisition may vary not only for different RTP receivers but also over time.

To increase the visibility of the multicast service provider into its network, to diagnose slow multicast acquisition issues and to collect the acquisition experiences of the RTP receivers, this document defines a new report block type, which is called Multicast Acquisition (MA) Report Block, within the framework of RTCP XR. RTP receivers that are using the method described in [I-D.ietf-avt-rapid-acquisition-for-rtp] MAY use this report every time they join a new multicast RTP session. RTP receivers that use a different method for rapid acquisition or those do not use any method but rather do a simple multicast join MAY also use this report. This way, the multicast service provider can quantitatively compare the improvements achieved by different methods.
2. Requirements Notation

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 [RFC2119].
3. Definitions

This document uses the following acronyms and definitions from [I-D.ietf-avt-rapid-acquisition-for-rtp]:

Primary Multicast Session:  A multicast session which RTP receivers can join at a random point in time.

Primary Multicast Stream:  The RTP stream to be acquired by the RTP receiver.

Source Filtering Group Management Protocol (SFGMP):  Following the definition in [RFC4604], SFGMP refers to the Internet Group Management Protocol (IGMP) version 3 [RFC3376] and the Multicast Listener Discovery Protocol (MLD) version 2 [RFC3810] in the IPv4 and IPv6 networks, respectively.

Retransmission Packet:  An RTP packet that is formatted as defined in [RFC4588].

Reference Information:  The set of certain media content and metadata information that is sufficient for an RTP receiver to start usefully consuming a media stream.  The meaning, format and size of this information are specific to the application.

(Unicast) Burst (Stream):  A unicast stream of RTP retransmission packets that enable an RTP receiver to rapidly acquire the Reference Information.  The burst stream is typically transmitted at an accelerated rate.

Retransmission Server (RS):  The RTP/RTCP endpoint that can generate the retransmission packets and the burst stream.
This section defines the format of the MA report block. The base report is payload-independent. An extension mechanism is provided where further optional payload-independent and payload-specific information can be included in the report as desired.

The optional extensions that are defined in this document are primarily developed for the method presented in [I-D.ietf-avt-rapid-acquisition-for-rtp]. Other methods that provide rapid acquisition of multicast streams MAY define their own extensions to be used in the MA report block.

The packet format for the RTCP XR is defined in Section 2 of [RFC3611]. Each XR packet has a fixed-length field for version, padding, reserved bits, payload type (PT), length, SSRC of packet sender as well as a variable-length field for report blocks. In the XR packets, the PT field is set to XR (207).

4.1. Base Report

The base report format is shown in Figure 1.

```
+-----------------------------+-------------------------------+-----------------------------+
|                     BT=TBD    |                     MA Method |                     Block Length |
+-----------------------------+-------------------------------+-----------------------------+
|                 SSRC of the Primary Multicast Stream |       |
+-----------------------------+-------------------------------+-----------------------------+
|                          Status Code |                   Rsvd. |
+-----------------------------+-------------------------------+-----------------------------+
```

Figure 1: Base report format for the MA report block

- **BT (8 bits):** Mandatory field that denotes the type for this block format. The MA report block is identified by the constant TBD.

- **MA Method (8 bits):** Mandatory field that denotes the type of the MA method (e.g., simple join, RAMS, etc.). See Section 7.3 for details.

- **Block Length (16 bits):** The length of this report block, including the header, in 32-bit words minus one.

- **SSRC of the Primary Multicast Stream (32 bits):** Mandatory field that denotes the SSRC of the primary multicast stream.
o Status Code (16 bits): Mandatory field that denotes the status code for the MA operation. The status codes will be registered with and maintained by IANA.

Editor’s note: Several status codes will be defined in this document in a later version. Vendors that want to use specific status codes for their specific implementations can use the private extensions.

o Rsvd. (16 bits): This field SHALL be set to 0.

If the multicast join was successful meaning that at least one multicast packet has been received, some additional information MUST be appended to the base report as described in Section 4.2.1.

4.2. Extensions

To improve the reporting scope, it may be desirable to define new fields in the MA report block. Such fields MUST be encoded as TLV elements as described below and sketched in Figure 2:

- Type: A single-octet identifier that defines the type of the parameter represented in this TLV element.

- Length: A two-octet field that indicates the length of the TLV element excluding the Type and Length fields in octets. Note that this length does not include any padding that is required for alignment.

- Value: Variable-size set of octets that contains the specific value for the parameter.

If a TLV element does not fall on a 32-bit boundary, the last word MUST be padded to the boundary using further bits set to zero.

In the MA report block, any vendor-neutral or private extension MUST be placed after the base report. The support for extensions is OPTIONAL.
4.2.1. Vendor-Neutral Extensions

If the goal in defining new TLV elements is to extend the report block in a vendor-neutral manner, they MUST be registered with IANA through the guidelines provided in Section 7.4.

The current document defines several vendor-neutral extensions. First, we present the TLV elements that can be used by any RTP-based multicast application.

- **Extended RTP Seqnum of First Multicast Packet**: TLV element that specifies the extended RTP sequence number of the first multicast packet received for the primary multicast stream. If the multicast join was successful, this element MUST exist. If no multicast packet has been received, this element SHALL NOT exist.

  Type: TBD

  Length: TBD

- **SFGMP Join Time**: TLV element that denotes the greater of zero or the time difference (in ms) between the instant SFGMP Join message has been sent and the instant the first RTP packet was received from the primary multicast session. If the multicast join was successful, this element MUST exist. If no multicast packet has been received, this element SHALL NOT exist.

  Type: TBD

  Length: TBD

- **Application Request-to-Multicast Delta Time**: Optional TLV element that denotes the time difference (in ms) between the instant the application became aware it would join a new multicast session and the instant the first RTP multicast packet was received for the primary multicast stream. If no such packet has been received, this element SHALL NOT exist.

  Type: TBD

  Length: TBD

- **Application Request-to-Presentation Delta Time**: Optional TLV element that denotes the time difference (in ms) between the instant the application became aware it would join a new multicast session and the instant the media is first presented. If the RTP
receiver cannot successfully present the media, this element SHALL NOT exist.

Type: TBD
Length: TBD

We next present the TLV elements that can be used when the RTP receiver supports and uses the RAMS method described in [I-D.ietf-avt-rapid-acquisition-for-rtp]. However, if the RTP receiver does not send a rapid acquisition request, the following TLV elements MUST NOT exist in the MA report block. Some elements may or may not exist depending on whether the RTP receiver receives any packet from the unicast and/or the primary multicast session or not. These are explained below.

- Application Request-to-RAMS Request Delta Time: Optional TLV element that denotes the time difference (in ms) between the instant the application became aware it would request a rapid acquisition and the instant the rapid acquisition request was actually sent by the application.
  
  Type: TBD
  Length: TBD

- RAMS Request-to-RAMS Information Delta Time: Optional TLV element that denotes the time difference (in ms) between the instant the rapid acquisition request has been sent and the instant the first RAMS Information packet was received from the unicast session. If no such packet has been received from the unicast session, this element SHALL NOT exist.
  
  Type: TBD
  Length: TBD

- RAMS Request-to-Burst Delta Time: Optional TLV element that denotes the time difference (in ms) between the instant the rapid acquisition request has been sent and the instant the first burst packet was received from the unicast session. If no RTP packet has been received from the unicast session, this element SHALL NOT exist.
  
  Type: TBD
  Length: TBD
o RAMS Request-to-Multicast Delta Time: Optional TLV element that
denotes the time difference (in ms) between the instant the rapid
acquisition request has been sent and the instant the first RTP
multicast packet was received for the primary multicast stream.
If no such packet has been received, this element SHALL NOT exist.

  Type: TBD
  Length: TBD

o RAMS Request-to-Burst-Completion Delta Time: Optional TLV element
that denotes the time difference (in ms) between the instant the
rapid acquisition request has been sent and the instant the last
burst packet was received from the unicast session. If no RTP
packet has been received from the unicast session, this element
SHALL NOT exist.

  Type: TBD
  Length: TBD

o Number of Duplicate Packets: Optional TLV element that denotes
the number of duplicate packets due to receiving the same packet
from both unicast and primary multicast sessions. If no RTP
multicast packet has been received for the primary multicast
stream, this element SHALL NOT exist. If no RTP packet has been
received from the unicast session, the value of this element SHALL
be set to zero.

  Type: TBD
  Length: TBD

o Size of Burst-to-Multicast Gap: Optional TLV element that denotes
the greater of zero or the difference between the sequence number
of the first multicast packet (received for the primary multicast
stream) and the sequence number of the last burst packet minus 1
(considering the wrapping of the sequence numbers). If no RTP
packet has been received from the unicast session or no RTP
multicast packet has been received for the primary multicast
stream, this element SHALL NOT exist.

  Type: TBD
  Length: TBD
4.2.2. Private Extensions

It is desirable to allow vendors to use private extensions in TLV format. For interoperability, such extensions MUST NOT collide with each other.

A certain range of TLV Types is reserved for private extensions (Refer to Section 7.4). IANA management for these extensions is unnecessary and they are the responsibility of individual vendors.

The structure that MUST be used for the private extensions is depicted in Figure 3. Here, the enterprise numbers are used from http://www.iana.org/assignments/enterprise-numbers. This will ensure the uniqueness of the private extensions and avoid any collision.

```
0                   1                   2                   3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      Type     |            Length             |  Ent. Number  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|               Ent. Number contd.              |     Value     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Value contd.                         /   
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 3: Structure of a private extension
5. Session Description Protocol Signaling

A new parameter is defined for the MA report block to be used with Session Description Protocol (SDP) [RFC4566]. It has the following syntax within the ‘rtcp-xr’ attribute:

```
rtcp-xr-attrib = "a=rtcp-xr:" [xr-format *(SP xr-format)] CRLF
xr-format = "multicast-acq"
CRLF = %d13.10
```

Figure 4

Refer to Section 5.1 of [RFC3611] for a detailed description and the full syntax of the "rtcp-xr" attribute.
6. Security Considerations

The security considerations of [RFC3611] apply in this document as well. If desired, similar to other RTCP XR reports, the MA reports MAY be protected by using SRTP and SRTCP [RFC3711].

Using the MA reports to provide feedback into the acquisition of the multicast streams can introduce possible additional security implications. If a forged or otherwise modified MA report is received for an earlier acquisition attempt, invalid data may be used as input in later rapid acquisition attempts. For example, incorrectly small SFGMP join times may cause the unicast burst to be too short, leading to gaps in sequence numbers in the approach discussed in [I-D.ietf-avt-rapid-acquisition-for-rtp]. Additionally, forged reports may give the appearance that rapid acquisition is performing correctly, when it is in fact failing, or vice versa.

Further security considerations are TBD.
7. IANA Considerations

7.1. RTCP XR Block Type

New block types for RTCP XR are subject to IANA registration. For general guidelines on IANA considerations for RTCP XR, refer to [RFC3611].

This document (provisionally) assigns the block type value TBD in the RTCP XR Block Type Registry to "Multicast Acquisition Report Block."

7.2. RTCP XR SDP Parameter

This document registers the SDP [RFC4566] parameter ‘multicast-acq’ for the ’rtcp-xr’ attribute in the RTCP XR SDP Parameters Registry.

The contact information for the registrations is:

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170 West Tasman Drive
San Jose, CA 95134 USA

7.3. Multicast Acquisition Method Registry

This document creates a new IANA registry for the MA methods. The registry is called the Multicast Acquisition Method Registry. This registry is to be managed by the IANA according to the Specification Required policy of [RFC5226].

The length of the MA Method field is a single octet, allowing 256 values. The registry is initialized with the following entries:

<table>
<thead>
<tr>
<th>MA Method</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Simple join (No explicit method)</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>RAMS</td>
<td>[I-D.ietf-avt-rapid-acquisition-for-rtp]</td>
</tr>
</tbody>
</table>

The MA Method values 0 and 255 are reserved for future use.

Any registration for an unassigned value MUST contain the following information:
7.4. Multicast Acquisition Report Block TLV Space Registry

This document creates a new IANA TLV space registry for the MA report block extensions. The registry is called the Multicast Acquisition Report Block TLV Space Registry. This registry is to be managed by the IANA according to the Specification Required policy of [RFC5226].

The length of the Type field in the TLV elements is a single octet, allowing 256 values. The registry is initialized with the following entries:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBD</td>
<td>Extended RTP Seqnum of First Multicast Packet</td>
<td>This document</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

The registry entries are TBC.

The Type values 0 and 255 are reserved for future use. The Type values between (and including) 128 and 254 are reserved for private extensions.

Any registration for an unassigned Type value MUST contain the following information:

- Contact information of the one doing the registration, including at least name, address, and email.
- A detailed description of what the new TLV element represents and how it shall be interpreted.
8. Acknowledgments

This specification has greatly benefited from discussions with Michael Lague, Dong Hsu, Carol Iturralde, Xuan Zhong, Dave Oran, Tom Van Caenegem and many others. The authors would like to thank each of these individuals for their contributions.
9. References

9.1. Normative References


9.2. Informative References


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