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Abstract

[I-D.ietf-avt-rapid-acquisition-for-rtp] defines a method for rapid acquisition of multicast sessions (RAMS). Upon accepting the first RAMS-R message, RS MUST echo an RAMS-I message as a response to RR. This document proposes to optionally convey a parameter called unicast backspace in the RAMS-I message. Unicast backspace is the RTP timestamp difference between the first unicast burst packet to be sent and the latest primary multicast packet in the buffer of RS. The RTP timestamps values for these packets are taken from the primary multicast stream. The parameter is a constant once RS chooses a starting point for the unicast burst. This parameter can be used by RR to determine when to join the primary multicast session. RR would not rely on RAMS-I to revise the earliest multicast join time after the burst rate is changed by RS and therefore is immune to the lose of RAMS-I. Moreover, if this parameter is known, RR with appropriate playback control can reduce the additional end-to-end delay introduced by the RAMS process or can enable the RS to serve the RR with shorter burst duration and therefore save the bandwidth of RS export and the burst forwarding path.

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1. Introduction

Per [I-D.ietf-avt-rapid-acquisition-for-rtp], RS may change the unicast burst rate during the acquisition process, decided by itself or based on some feedback information from RR. RS may therefore recalculate the earliest multicast join time and send the revised values to RR using additional RAMS-I messages. If such an RAMS-I message gets lost, RR would fail to update its multicast join time accordingly and therefore join the multicast session at an inappropriate time. This increases the chance and amount of overlap or gap between the unicast burst and primary multicast stream. In order to solve this problem, this document proposes to convey a field called unicast backspace in the first RAMS-I message which is as a response to the acceptance of the first RAMS-R message. Unicast backspace is the RTP time stamp difference between the first unicast burst packet to be sent and the latest primary multicast packet in the buffer of RS. The RTP timestamps values for these packets are taken from the primary multicast stream.

Unicast backspace is a constant once the start point of the unicast burst is decided by RS. This value, in conjunction with some parameters that are known to RR, e.g. burst rate, playback rate, amount of buffered data, and initial playback delay, can be used by RR to heuristically determine when to launch multicast join process by sending an SFQMP join message. RR therefore may not count on RAMS-I to notify the SFQMP join time update due to burst rate change during the rapid acquisition and therefore may alleviate the RS implementation complexity for re-deducing multicast join time. And this way, the amount of protocol signaling interaction between RS and RR may be reduced. Furthermore, when unicast backspace value is known, RR may remove or reduce the additional end-to-end delay introduced by the RAMS process by appropriately controlling the playback process, such that the playback can be synchronized with other users of the same primary multicast session.

Note that how RR uses this field to deduce when RR launch the multicast join process is out of scope of this document.

2. Conventions

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. Unicast Backspace Field

Unicast backspace (32 bits): Optional TLV element. This field gives the RTP timestamp difference between the first unicast burst packet to be sent and the latest primary multicast packet in the buffer. The RTP timestamps values for these packets are taken from the primary multicast stream. The value of unicast backspace indicates the amount of data that would be additional transmitted to RR compared to when the RAMS process is not in use. This field SHOULD be conveyed in the first RAMS-I message and MAY be conveyed in other RAMS-I messages. RR MAY use this field to determine when to join the multicast session by sending an SFGMP join message.

4. Example Message Flow

Figure 1 depicts an example of messaging flow for RR using backspace field to heuristically determine the multicast join time.

```
+-----------+   +----------------+   +----------+   +------------+
| Multicast |   | Retransmission |   |          |   |    RTP     |
| Source    |   |     Server     |   |  Router  |   |  Receiver  |
|           |   |      (RS)      |   |          |   |    (RR)    |
+-----------+   +----------------+   +----------+   +------------+

|-- RTP Multicast ------------------->|
|-- RTP Multicast ->|

""" RTCP RAMS-R """'

"" (RTCP RAMS-I with """"'"""")> unicast backspace

.. Unicast RTP Burst ............>

""" (RTCP RAMS-R)"""'

<~ SFGMP Join ~>

Figure 1 Message Flow for heuristic IGMP Join Time Determination

"""> Unicast RTCP Messages
The example is described by the following steps:

1. RR sends an RTCP RAMS-R message to RS to request a rapid acquisition process.

2. Upon accepting of the RAMS-R message, RS sends an RTCP RAMS-I message with unicast backspace field to RR.

3. RS transmit Unicast RTP Burst to RR.

4. During the burst, RR uses the value of unicast backspace to determine when to send SFGMP Join message to join the primary multicast group. For example, RR (periodically) estimates the buffer occupation in terms of media timestamp offset between the first and the last RTP packets in the buffer (called B for example). If the difference between the unicast backspace value and B is less than or equal to a pre-defined threshold value, RR begins to join the multicast session. Unicast backspace is a determinate value and is always fixed during the burst. The amount of data in the buffer is known by RR. The threshold value can be derived as equal to

\[
(\frac{(b_r - p_r)}{p_r}) \times \text{multicast_join_latency}
\]

where \(b_r\) is the burst rate, \(p_r\) is the playback rate, and \(\text{multicast_join_latency}\) is the delay between RR sending SFGMP join message and RR getting the first primary multicast packet.

This way, RR would not rely on RAMS-I to revise the earliest multicast join time after the burst rate is changed by RS.

In addition to calculating multicast join time, when the unicast backspace is known, RR may remove or reduce the additional end-to-end delay introduced by the RAMS process by appropriately controlling the playback process, for example speeding up the playback, such that the playback can be synchronized with other users of the same primary multicast session. Or on the other hand, with this parameter, RR may lower the playback to prevent its de-jitter and retransmission buffer from under-run. This way, RS can tailor the burst in shorter burst duration and thus save the bandwidth of RS export and the burst forwarding path.
5. Security Considerations

TBD.

6. IANA Considerations

TBD

7. References

7.1. Normative References

[I-D.ietf-avt-rapid-acquisition-for-rtp]

B. VerSteeg, A. Begen, T. VanCaenegem, Z. Vax, "Unicast-Based Rapid Acquisition of Multicast RTP Sessions", Oct 8, 2009


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