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Considerations and Guidelines for Deploying the Rapid Acquisition of
Multicast RTP Sessions (RAMS) Method
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Abstract

The Rapid Acquisition of Multicast RTP Sessions (RAMS) solution is a method based on RTP and RTP Control Protocol (RTCP) that enables an RTP receiver to rapidly acquire and start consuming the RTP multicast data. Upon a request from the RTP receiver, an auxiliary unicast RTP retransmission session is set up between a retransmission server and the RTP receiver, over which the reference information about the new multicast stream the RTP receiver is about to join is transmitted at an accelerated rate. This often precedes, but may also accompany, the multicast stream itself. When there is only one multicast stream to be acquired, the RAMS solution works in a straightforward manner. However, when there are two or more multicast streams to be acquired from the same or different multicast RTP sessions, care should be taken to configure each RAMS session appropriately. This document provides example scenarios and offers guidelines.

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1. Introduction

The Rapid Acquisition of Multicast RTP Sessions (RAMS) solution is a method based on RTP and RTP Control Protocol (RTCP) that enables an RTP receiver to rapidly acquire and start consuming the RTP multicast data. Through an auxiliary unicast RTP retransmission session [RFC4588], the RTP receiver receives a reference information about the new multicast stream it is about to join. This often precedes, but may also accompany, the multicast stream itself. The RAMS solution is documented in detail in [I-D.ietf-avt-rapid-acquisition-for-rtp].

The RAMS specification [I-D.ietf-avt-rapid-acquisition-for-rtp] has provisions for concurrently acquiring multiple streams inside a multicast RTP session. However, the specification has mostly focused on the simplest case, which is when the RTP receiver acquires only one multicast stream at a time, to explain the protocol details.

There are certain deployment models where a multicast RTP session may have two or more multicast streams associated with it. There are also cases, where an RTP receiver may be interested in acquiring one or more multicast streams from several multicast RTP sessions. In scenarios where multiple RAMS sessions will be simultaneously run by an RTP receiver, they need to be coordinated. In this document, we present scenarios from real-life deployments and provide guidelines.

2. Requirements Notation

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

Editor's note: I am inclined not use any 2119 keyword in this document and remove this section altogether.

3. Background

In the following discussion, we assume that there are two RTP streams (1 and 2) that are somehow associated with each other. These could be audio and video elementary streams for the same TV channel, or they could be an MPEG2-TS stream (that has audio and video multiplexed together) and its Forward Error Correction (FEC) stream.

It is important to note that a source-specific multicast (SSM) session is defined by its (distribution) source address and

(destination) multicast group and there can be only one feedback target per SSM session [RFC5760]. So, if the RTP streams are distributed by different sources or over different multicast groups, they are considered different SSM sessions. While different SSM sessions can normally share the same feedback target address and/or port, RAMS requires each unique feedback target (i.e., the combination of address and port) to be associated with at most one RTP session (See Section 6.2 of [I-D.ietf-avt-rapid-acquisition-for-rtp]).

Two or more multicast RTP streams can be transmitted in the same RTP session (i.e., in a single UDP flow). This is called Synchronization Source (SSRC) multiplexing. In this case, (de)multiplexing is done at the SSRC level. Alternatively, the multicast RTP streams can be transmitted in different RTP sessions (i.e., in different UDP flows), which is called session multiplexing. In practice, there are different deployment models for each multiplexing scheme.

Generally, two different media streams with different clock rates are suggested to use different SSRCs or to be carried in different RTP sessions to avoid complications in RTCP reports. Some of the fields in RAMS messages might depend on the clock rate. Thus, in a single RTP session, RTP streams carrying payloads with different clock rates need to have different SSRCs. Since RTP streams in the same RTP session but with different SSRCs do not share the sequence numbering, each stream needs to be acquired individually.

In the remaining sections, only the relevant portions of the SDP descriptions [RFC4566] will be provided. For an example of a full SDP description, refer to Section 8.3 of [I-D.ietf-avt-rapid-acquisition-for-rtp].

4. Example Scenarios

4.1. Scenario #1: Two Multicast Groups

This is the scenario for session multiplexing where RTP streams 1 and 2 are transmitted over different multicast groups. A practical use case is where the first and second SSM sessions carry the primary video stream and its associated FEC stream, respectively.

We run an individual RAMS session for each of these RTP streams that we want to rapidly acquire. These RAMS sessions can be run in parallel. If they are, the RTP receiver needs to pay attention to using the shared bandwidth appropriately among the two unicast bursts. As explained earlier, there has to be a different feedback target for these two SSM sessions.

```
a=group:FEC-FR Channell_Video Channell_FEC
m=video 40000 RTP/AVPF 96
c=IN IP4 233.252.0.1/127
a=source-filter:incl IN IP4 233.252.0.1 198.51.100.1
a=rtcp:41000 IN IP4 192.0.2.1
a=ssrc:1 cname:chl_video@example.com
a=mid:Channell_Video
m=application 40000 RTP/AVPF 97
c=IN IP4 233.252.0.2/127
a=source-filter:incl IN IP4 233.252.0.2 198.51.100.1
a=rtcp:42000 IN IP4 192.0.2.1
a=ssrc:2 cname:chl_fec@example.com
a=mid:Channell_FEC
```

Note that the multicast destination ports in the above SDP do not matter, and they could be the same or different. The "FEC-FR" grouping semantics are defined in [RFC5956].

4.2. Scenario #2: One Multicast Group

This is the scenario for session multiplexing where RTP streams 1 and 2 are transmitted over the same multicast group with different destination ports. A practical use case is where the SSM session carries the primary video and audio streams, each destined to a different port.

Similar to scenario #1, we run individual RAMS sessions for each RTP stream that we want to rapidly acquire (Note that the RAMS request sent by an RTP receiver could indicate the desire to acquire all or a subset or one of the available RTP streams in an SSM session). Compared to the previous scenario, the only difference is that in this case the join times for both streams need to be coordinated as they are on the same multicast session.

```
m=video 40000 RTP/AVPF 96
c=IN IP4 233.252.0.1/127
a=source-filter:incl IN IP4 233.252.0.1 198.51.100.1
a=rtcp:41000 IN IP4 192.0.2.1
a=ssrc:1 cname:chl_video@example.com
a=mid:Channell_Video
m=audio 40001 RTP/AVPF 97
c=IN IP4 233.252.0.1/127
a=source-filter:incl IN IP4 233.252.0.1 198.51.100.1
a=rtcp:41000 IN IP4 192.0.2.1
a=ssrc:2 cname:chl_audio@example.com
a=mid:Channell_Audio
```

Note that the destination ports in the above SDP need to be distinct per [RFC5888].

If RTP streams 1 and 2 share the same distribution source, then there is only one SSM session, which means that there can be only one feedback target (as shown in the SDP description above). This requires RTP streams 1 and 2 to have their own unique SSRC values (also as shown in the SDP description above). If RTP streams 1 and 2 do not share the same distribution source, meaning that their respective SSM sessions can use different feedback target transport addresses, then their SSRC values do not have to be different from each other.

4.3. Scenario #3: SSRC Multiplexing

This is the scenario for SSRC multiplexing where both RTP streams are transmitted over the same multicast group to the same destination port. This is a less practical scenario but it could be used where the SSM session carries both the primary video and audio stream, destined to the same port.

Similar to scenario #2, we run individual RAMS sessions and the join time needs to be coordinated. In this case, there is only one distribution source and the destination multicast address is shared. Thus, there is always one SSM session and one feedback target.

```
m=video 40000 RTP/AVPF 96 97
c=IN IP4 233.252.0.1/127
a=source-filter:incl IN IP4 233.252.0.1 198.51.100.1
a=rtcp:41000 IN IP4 192.0.2.1
a=ssrc:1 cname:chl_video@example.com
a=ssrc:2 cname:chl_audio@example.com
a=mid:Channell
```

4.4. Scenario #4: Payload-Type Multiplexing

This is the scenario for payload-type multiplexing.

In this case, instead of two, we have only one RTP stream (and one RTP session) carrying both payload types (e.g., media payload and its FEC data). While this scheme is permissible per [RFC3550], it has several drawbacks. For example, RTP packets carrying different payload formats will share the same sequence numbering space, and the retransmission and RAMS operations will not be able to be applied based on the payload type. For other drawbacks and details, see Section 5.2 of [RFC3550].

5. Feedback Target and SSRC Signaling Issues

The RAMS protocol uses the common packet format from [RFC4585], which has a field to signal the media sender SSRC. The SSRCs for the RTP streams can be signaled out-of-band in the SDP, or could be learned from the RTP packets once the transmission starts. In RAMS, the latter cannot be used.

Signaling the media sender SSRC value helps the feedback target correctly identify the RTP stream to be acquired. If a feedback target is serving multiple SSM sessions on a particular port, all the RTP streams in these SSM sessions are supposed to have a unique SSRC value. However, since this is not an easy requirement to satisfy, RAMS specification forbids to have more than one RTP session to be associated with a specific feedback target.

6. FEC during RAMS and Bandwidth Issues

Suppose that RTP stream 1 denotes the primary video stream that has a bitrate of 10 Mbps and RTP stream 2 denotes the FEC stream that has a bitrate of 1 Mbps. Also assume that the RTP receiver knows that it can receive data at a maximum bitrate of 22 Mbps. SDP can specify the bitrate ("b=" line in Kbps) of each media session (per "m" line).

6.1. Scenario #1

This is the scenario for session multiplexing where RTP streams 1 and 2 are transmitted over different multicast groups.

This is the preferred deployment model for FEC. Having FEC in a different multicast group provides flexibility for not only the RTP receivers that are not FEC capable but also the ones that are FEC capable but are not willing to receive FEC during the rapid acquisition.

```
a=group:FEC-FR Channell_Video Channell_FEC
m=video 40000 RTP/AVPF 96
c=IN IP4 233.252.0.1/127
a=source-filter:incl IN IP4 233.252.0.1 198.51.100.1
a=rtcp:41000 IN IP4 192.0.2.1
a=rtpmap:96 MP2T/90000
b=TIAS:10000
a=ssrc:1 cname:ch1_video@example.com
a=mid:Channell_Video
m=application 40000 RTP/AVPF 97
c=IN IP4 233.252.0.2/127
a=source-filter:incl IN IP4 233.252.0.2 198.51.100.1
a=rtcp:42000 IN IP4 192.0.2.1
a=rtpmap:97 1d-interleaved-parityfec/90000
b=TIAS:1000
a=ssrc:2 cname:ch1_fec@example.com
a=mid:Channell_FEC
```

If the RTP receiver does not want to receive FEC until the acquisition of the primary video stream is completed, the total available bandwidth can be used for faster acquisition of the primary video stream. In this case, the RTP receiver can request a Max Receive Bitrate of 22 Mbps in the RAMS Request message. Once RAMS has been completed, the RTP receiver can join the FEC multicast session, if desired.

If the RTP receiver wants to rapidly acquire both primary and FEC streams, it needs to allocate the total bandwidth among the two RAMS sessions and indicate individual Max Receive Bitrate values in each respective RAMS Request message. Since less bandwidth will be used to acquire the primary video stream, the acquisition of the primary video session will take a longer time on the average.

While the RTP receiver can update the Max Receive Bitrate values during the course of the RAMS session, this approach is more error-prone due to the possibility of losing the update messages.

6.2. Scenario #2

This is the scenario for session multiplexing where RTP streams 1 and 2 are transmitted over the same multicast group with different destination ports.

```
a=group:FEC-FR Channell_Video Channell_FEC
m=video 40000 RTP/AVPF 96
c=IN IP4 233.252.0.1/127
a=source-filter:incl IN IP4 233.252.0.1 198.51.100.1
a=rtcp:41000 IN IP4 192.0.2.1
a=rtpmap:96 MP2T/90000
b=TIAS:10000
a=ssrc:1 cname:chl_video@example.com
a=mid:Channell_Video
m=application 40001 RTP/AVPF 97
c=IN IP4 233.252.0.1/127
a=source-filter:incl IN IP4 233.252.0.1 198.51.100.1
a=rtcp:41000 IN IP4 192.0.2.1
a=rtpmap:97 ld-interleaved-parityfec/90000
b=TIAS:1000
a=ssrc:2 cname:chl_fec@example.com
a=mid:Channell_FEC
```

Similar to scenario #1, the RTP receiver can first ask for RAMS for the primary video stream at the full receive bitrate. But, upon the multicast join, the available bandwidth for the burst drops to 11 Mbps instead of 12 Mbps. Regardless of whether FEC is desired or not by the RTP receiver, its bitrate needs to be taken into account once the RTP receiver joins the SSM session.

If the RTP receiver wants to rapidly acquire both primary and FEC streams, the same conditions explained for scenario #1 apply. The only difference from scenario #1 is that here the join time is the same for both the primary video and FEC streams.

6.3. Scenario #3

This is the scenario for SSRC multiplexing where both RTP streams are transmitted over the same multicast group to the same destination port.

```
m=video 40000 RTP/AVPF 96 97
c=IN IP4 233.252.0.1/127
a=source-filter:incl IN IP4 233.252.0.1 198.51.100.1
a=rtcp:41000 IN IP4 192.0.2.1
a=rtpmap:96 MP2T/90000
a=rtpmap:97 ld-interleaved-parityfec/90000
a=fmtp:97 L=10; D=10; repair-window=200000
a=ssrc:1 cname:chl_video@example.com
a=ssrc:2 cname:chl_fec@example.com
a=mid:Channell
b=TIAS:11000
a=mid:Channell
```

This is similar to scenario #2. However, since we cannot explicitly specify the bitrates for the primary and FEC streams, the RTP receiver can request to rapidly acquire both streams in parallel. In this case, two separate RAMS Request messages have to be sent by the RTP receiver to the feedback target.

Note that based on the "a=fmtp" line for the FEC stream, it could be possible to infer the bitrate of this FEC stream and set the Max Receive Bitrate value accordingly.

7. Security Considerations

There are no security considerations in this document.

8. IANA Considerations

There are no IANA considerations in this document.

9. Acknowledgments

I would like to thank various individuals in the AVTEXT and MMUSIC WGs, and my friends at Cisco for their comments and feedback.

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