Considerations 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 discusses how the RAMS solution could be used in such scenarios.

Table of Contents

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 [RFC6285].

The RAMS specification [RFC6285] has provisions for concurrently acquiring multiple streams inside a multicast RTP session. However, the RAMS specification does not discuss scenarios where an RTP receiver makes use of the RAMS method to rapidly acquire multiple and associated multicast streams in parallel, or where different RTP sessions are part of the same source-specific multicast (SSM) session. The example presented in Section 8.3 of [RFC6285] addresses only the simple case of an RTP receiver rapidly acquiring only one multicast stream to explain the protocol details.

There are certain deployment models where a multicast RTP session might have two or more multicast streams associated with it. There are also cases, where an RTP receiver might be interested in acquiring one or more multicast streams from several multicast RTP sessions. In scenarios where multiple RAMS sessions, each initiated with an individual RAMS Request message to a different feedback target, will be simultaneously run by an RTP receiver, they need to be coordinated. In this document, we present scenarios from real-life deployments and discuss how the RAMS solution could be used in such scenarios.

2. 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.

An 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 [RFC6285]).

Two or more multicast RTP streams can be transmitted in the same RTP session (e.g., 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 (e.g., 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 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 [RFC6285].

3. Example Scenarios

3.1. 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. Each requires a separate RAMS Request message to be sent. 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 Channel1_Video Channel1_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:ch1_video@example.com
a=mid:Channel1_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:ch1_fec@example.com
a=mid:Channel1_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].

3.2. Scenario #2: One Multicast Group

Here 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.

The RAMS Request message sent by an RTP receiver to the feedback target could indicate the desire to acquire all or a subset or one of the available RTP streams. Thus, both the primary video and audio streams can be acquired rapidly in parallel. Or, the RTP receiver can acquire only the primary video or audio stream, if desired, by indicating the specific SSRC in the request. 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 delivered in 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:ch1_video@example.com
a=mid:Channel1_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:ch1_audio@example.com
a=mid:Channel1_Audio
```

Note that the destination ports in "m" lines 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.

3.3. 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, both the primary video and audio streams can be acquired rapidly in parallel. Or, the RTP receiver can acquire only the primary video or audio stream, if desired, by indicating the specific SSRC in the request. 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:ch1_video@example.com
a=ssrc:2 cname:ch1_audio@example.com
a=mid:Channel1
```

3.4. 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 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].

4. 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, this is not an easy requirement to satisfy. Thus, RAMS specification forbids to have more than one RTP session to be associated with a specific feedback target on a specific port.

5. 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 associated 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).

5.1. 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 [RFC6363]. Having FEC in a different multicast group provides two flexibility points: RTP receivers that are not FEC capable can receive the primary video stream without FEC, and RTP receivers that are FEC capable can decide to not receive FEC during the rapid acquisition (but still start receiving the FEC stream after the acquisition of the primary video stream has been completed).

```
a=group:FEC-FR Channel1_Video Channel1_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:Channel1_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:Channel1_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 for the primary video stream. 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.

5.2. Scenario #2

Here RTP streams 1 (primary video) and 2 (FEC) are transmitted over the same multicast group with different destination ports. This is not a preferred deployment model.

```
a=group:FEC-FR Channel1_Video Channel1_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:Channel1_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 1d-interleaved-parityfec/90000
b=TIAS:1000
a=ssrc:2 cname:ch1_fec@example.com
a=mid:Channel1_FEC
```

The RAMS Request message sent by an RTP receiver to the feedback target could indicate the desire to acquire all or a subset or one of the available RTP streams. Thus, both the primary video and FEC streams can be acquired rapidly in parallel sharing the same available bandwidth. Or, the RTP receiver can acquire only the primary video stream by indicating its specific SSRC in the request. In this case, the RTP receiver can first acquire 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.

5.3. 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 1d-interleaved-parityfec/90000
a=fmtp:97 L=10; D=10; repair-window=200000
a=ssrc:1 cname:ch1_video@example.com
a=ssrc:2 cname:ch1_fec@example.com
b=TIAS:11000
a=mid:Channel1
```

Similar to scenario #2, both the primary video and audio streams can be acquired rapidly in parallel. Or, the RTP receiver can acquire only the primary video stream, if desired, by indicating its specific SSRC in the request.

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.

6. Security Considerations

There are no security considerations in this document.

7. IANA Considerations

There are no IANA considerations in this document.

8. Acknowledgments

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9. References

9.1. Normative References

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Author's Address

Ali Begen
Cisco
181 Bay Street
Toronto, ON M5J 2T3
Canada

Email: abegen@cisco.com