     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.

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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 [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.

```
v=0
o=ali 1122334455 1122334466 IN IP4 rams.example.com
s=RAMS Scenarios
t=0 0
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.

```
        v=0
        o=ali 1122334455 1122334466 IN IP4 rams.example.com
        s=RAMS Scenarios
        t=0 0
        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.

```
        v=0
        o=ali 1122334455 1122334466 IN IP4 rams.example.com
        s=RAMS Scenarios
        t=0 0
        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).

```
v=0
o=ali 1122334455 1122334466 IN IP4 rams.example.com
s=RAMS Scenarios
t=0 0
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.

```
v=0
o=ali 1122334455 1122334466 IN IP4 rams.example.com
s=RAMS Scenarios
t=0 0
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.

```
v=0
o=ali 1122334455 1122334466 IN IP4 rams.example.com
s=RAMS Scenarios
t=0 0
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

   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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