RTCP Extension for Third-party Loss Report
draft-ietf-avtcore-feedback-supression-rtp-07

Abstract

In a large RTP session using the RTCP feedback mechanism defined in RFC 4585, a feedback target may experience transient overload if some event causes a large number of receivers to send feedback at once. This overload is usually avoided by ensuring that feedback reports are forwarded to all receivers, allowing them to avoid sending duplicate feedback reports. However, there are cases where it is not recommended to forward feedback reports, and this may allow feedback implosion. This memo discusses these cases and defines a new RTCP third-party loss report that can be used to inform receivers that the network is aware of some loss event, allowing them to suppress feedback. Associated SDP signalling is also defined.

Status of this Memo

Copyright Notice

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[1.](1.) Introduction

RTCP feedback messages [RFC4585] allow the receivers in an RTP session
to report events and ask for action from the media source (or a
delegated feedback target when using unicast RTCP feedback with SSM
[RFC5760]). There are cases where multiple receivers may initiate the
same, or an equivalent message towards the same media source. When the
receiver count is large, this behavior may cause transient overload of
the media source, the network or both. This is known as a "feedback
storm" or a "NACK storm". One common cause of such a feedback storm is
receivers utilizing RTP retransmission [RFC4588] as a packet loss
recovery technique based, sending feedback using RTCP NACK messages
[RFC4585] without proper dithering of the retransmission requests
(e.g., implementing the RFC 4585 dithering rules or sending NACKs to a
middlebox that doesn't redistribute them to other receivers).
Another use case involves video Fast Update requests. A storm of these
feedback messages can occur in conversational multimedia scenarios like
multipoint video switching conference [RFC4587]. In this scenario, the
receiver may lose synchronization with the video stream when speaker is
changed in the middle of session. Poorly designed receivers that
blindly issue fast update requests (i.e., Full Intra Request (FIR)
described in [RFC5104]), can cause an implosion of FIR requests from
receivers to the same media source.
RTCP feedback storms may cause short term overload, and in extreme
cases to pose a possible risk of increasing network congestion on the
control channel (e.g. RTCP feedback), the data channel, or both. It is
therefore desirable to provide a way of suppressing unneeded feedback.
One approach to this, suggested in [DVB-IPTV], involves sending a NACK
message to the other clients (or receiver) in the same group as the
sender of NACK. However NACK is defined as a receiver report sent from
a receiver observing a packet loss, therefore it only inform others
that sender of NACK detected loss while the case the sender of the
feedback has received reports that the indicated packets were lost is
not covered. This document specifies a new third-party loss report for
this function. It supplements the existing the use of RTCP NACK packet
and further is more precise in the uses where the network is active to
suppress feedback. It tells receivers explicitly that feedback for a
particular packet or frame loss is not needed for a period of time and
can provide an early indication before the receiver reacts to the loss
and invokes its packet loss repair machinery. Section 6 provides some
examples of when to send the Third Party Loss Report message. Section 6

provides some examples of when to send the Third Party Loss Report message.

2. Terminology

The keywords "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. Protocol Overview

This document extends the RTCP feedback messages defined in the Audio-Visual Profile with feedback (RTP/AVPF) [RFC4585] defining a Third Party Loss Report message. The Third Party Loss Report message can be used by the intermediaries to inform the receiver that the sender of the Third Party Loss Report has received reports that the indicated packets were lost, and asks the receiver not to send feedback to it regarding these packets.
RTCP Third Party Loss Report follows the similar format of message type as RTCP NACK or Full Intra Request Command. However, the Third Party Loss Report is defined as an indication that the sender of the feedback has received reports that the indicated packets were lost, while NACK [RFC4585] just indicates that the sender of the NACK observed that these packets were lost. The Third Party Loss Report message is generated by a RTP system that has not seen the actual packet loss and sent following the same timing rule as sending NACK defined in [RFC4585], e.g., The TPLR message may be sent in a regular full compound RTCP packet or in an early RTCP packet, as per AVPF. RTP Systems in the network that receive a Third Party Loss Report SHOULD NOT initiate their own additional Third Party Loss Report messages for the same packet sequence numbers. They should simply forward the Third Party Loss Report message received from upstream direction, additionally, they may generate their own Third Party Loss Report that reports a set of the losses they see, which are different from ones reported in the Third Party Loss report they received. The Third Party Loss Report does not have the retransmission request [RFC4588] semantics.
When a receiver gets a Third Party Loss Report message, it should start a timer for this message and refrain from sending a feedback request (e.g., NACK or FIR) for the missing packets reported in the message during the lifetime of the timer. The timer value shall be based on the observed round-trip time. A receiver should compute an estimate of the round-trip time (RTT) to the sender of TPLR from RTCP report round-trip time if available, or its reception time of the reflected RTCP FB message (e.g.,NACK), or any other means.
To increase the robustness to the loss of a TPLR or of a transmission packet, a receiver is allowed to receive additional TPLR for the same packet. In the case the first TPLR is lost and the additional TPLR arrives at the receiver, the receiver should immediately refresh the

timer. When the timer for this message expires and there is no retransmitted packet or a new Third Party Loss Report message, the receiver should take its normal behavior as if there is no current retransmission suppression.

A receiver may still have sent a Feedback message according to the RTP/ AVPF scheduling algorithm of [RFC4585] before receiving a Third Party Loss Report message, but further feedback messages for those sequence numbers will be suppressed by this technique for a certain period of time. Nodes that do not understand the Third Party Loss Report message will ignore it, and might therefore still send feedback according to the AVPF scheduling algorithm of [RFC4585]. The media source or intermediate nodes cannot assume that the use of a Third Party Loss Report message actually reduces the amount of feedback it receives. Since Third Party Loss Report interacts strongly with repair timing, it has to work together with feedback to not adversely impact the repair of lost source packets. In order not to incur a lot of NACK requests due to additional TPLR described above, it is recommended that the RTP system sending TPLR should be implemented more closer to the source. Also when the loss was detected and repair initiated much closer to the source, the delay for the receiver to recover from packet loss can be reduced through the combination of intermediary feedback to the source and Third Party Loss Report downstream.

4. Format of RTCP Feedback Messages

This document registers two new RTCP Feedback messages for Third Party Loss Report. Applications that are employing one or more loss- repair methods MAY use the Third Party Loss Report together with their existing loss-repair methods either for every packet they expect to receive, or for an application-specific subset of the RTP packets in a session. In other words, receivers MAY ignore Third Party Loss Report messages, but SHOULD react to them unless they have good reason to still send feedback messages despite having been requested to suppress them.

4.1. Transport Layer Feedback: Third-party Loss Report

This Third Party Loss Report message is an extension to the RTCP Transport Layer Feedback Report and identified by RTCP packet type value PT=RTPFB and FMT=TBD.

Within the common packet header for feedback messages (as defined in section 6.1 of [RFC4585]), the "SSRC of packet sender" field indicates the source of the request, and the "SSRC of media source" denotes the media sender.

The FCI field MUST contain one or more entries of transport layer third party loss Early Indication (TLLEI). Each entry applies to the same media source identified by the SSRC contained in the SSRC of media source field of Feedback header.

The Feedback Control Information (FCI) for TLLEI uses the similar
format of message Types defined in the section 6.2.1 of [RFC4585]. The
format is shown in Figure 1.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            PID                |            BLP                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
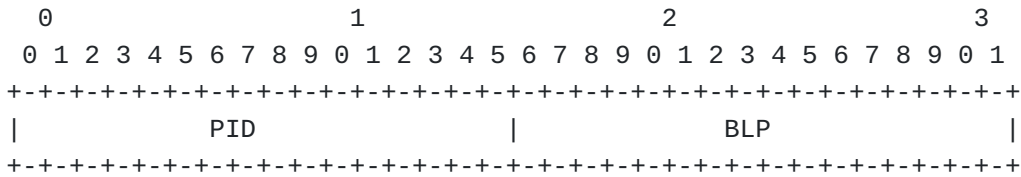
Packet ID (PID): 16 bits

   The PID field is used to specify a lost packet. The PID field refers
   to the RTP sequence number of the lost packet.

bitmask of proceeding lost packets (BLP): 16 bits

   The BLP allows for reporting losses of any of the 16 RTP packets
   immediately following the RTP packet indicated by the PID. The BLP's
   definition is identical to that given in [RFC4585].

4.2. Payload Specific Feedback: Third-party Loss Report

This message is an extension to the RTCP Payload Specific Feedback
report and identified by RTCP packet type value PT=PSFB and FMT=TBD,
which is used to suppress FIR [RFC5104]or PLI [RFC4585].
Within the common packet header for feedback messages (as defined in
section 6.1 of [RFC4585]), the "SSRC of packet sender" field indicates
the source of the request, and the "SSRC of media source" is not used
and SHALL be set to 0. The SSRCs of the media senders to which this
message applies are in the corresponding FCI entries.
The FCI field MUST contain a Payload Specific Third Party Loss Early
Indication (PSLEI) entry. Each entry applies to a different media
Source that is requested to send a decoder refresh point or that is
indicated that it lost synchronization with the video stream,
identified by its SSRC.
The Feedback Control Information (FCI) for PSLEI uses the similar
format of message Types defined in the section 4.3.1.1 of [RFC5104].
The format is shown in Figure 2.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                            SSRC                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Seq nr.    |                 Reserved                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
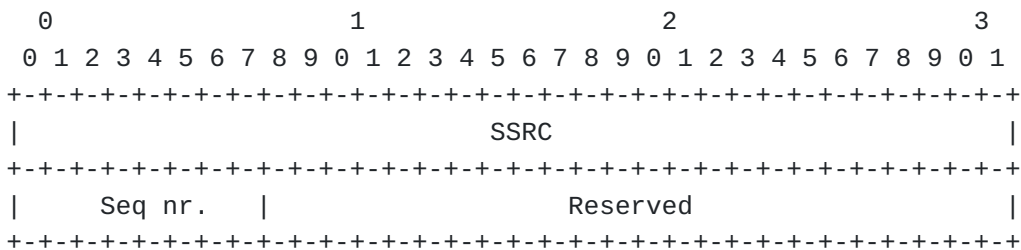
SSRC (32 bits):

The SSRC value of the media source that is requested to send a decoder refresh point or that is indicated that it lost synchronization with the video stream.

Seq nr:8bits Command sequence number. It is used by the Command receiver to check if the Command is repeated. The sequence number space is unique for each pairing of the SSRC of command sender and the SSRC of the command receiver. The sequence number SHALL increase by 1 modulo 256 for each new Command. A repetition SHALL NOT increase the sequence number. The initial value is arbitrary.

Reserved: 24 bits

All bits SHALL be set to 0 by the media source and SHALL be ignored on reception.

5. SDP Signaling

A new feedback value "tplr" needs to be defined for the Third Party Loss Report message to be used with Session Description Protocol (SDP) [RFC4566] using the Augmented Backus-Naur Form (ABNF) [RFC4585]. The "tplr" feedback value SHOULD be used with parameters that indicate the third party loss supported. In this document, we define two such parameter, namely:

In the ABNF for rtcp-fb-val defined in [RFC4585], there is a placeholder called rtcp-fb-id to define new feedback types. "tplr" is defined as a new feedback type in this document, and the ABNF for the parameters for tplr is defined here (please refer to section 4.2 of [RFC4585] for complete ABNF syntax).

  *"tllei" denotes support of transport layer third party loss early
   indication.

  *"pslei" denotes support of payload specific third party loss
   early indication.

```
rtcp-fb-val         =/ "tplr" rtcp-fb-tplr-param
rtcp-fb-tplr-param  = SP "tllei";transport layer third party loss early indication
                    / SP "pslei";payload specific third party loss early indication
                    / SP token [SP byte-string]
                                ; for future commands/indications
byte-string = <as defined in section 4.2 of [RFC4585] >
```

Refer to Section 4.2 of [RFC4585] for a detailed description and the
full syntax of the "rtcp-fb" attribute.

6. Example Use Cases

The operation of feedback suppression is similar for all types of RTP
sessions and topologies [RFC5117], however the exact messages used and
the scenarios in which suppression is employed differ for various use
cases. The following sections outline some of the intended use cases
for using the Third Party Loss Report for feedback suppression and give
an overview of the particular mechanisms.

6.1. Source Specific Multicast (SSM) use case

In SSM RTP sessions as described in [RFC5760], one or more Media
Sources send RTP packets to a Distribution Source. The Distribution
Source relays the RTP packets to the receivers using a source- specific
multicast group.
As outlined in the [RFC5760], there are two Unicast Feedback models
that may be used for reporting, the Simple Feedback model and the
Distribution Source Feedback Summary Model. In the simple Feedback
Model, there's no need for distribution source to create the Third
Party Loss Report, instead, NACKs are reflected by the distribution
source to the other Receivers. However in the Distribution Source
Feedback Summary model, the distribution source will not redistribute
the NACK for some reason(e.g., to prevent revealing the identity or
existence of a system sending NACK)and may send a Third Party Loss
Report to the systems that were unable to receive the NACK, and won't
receive the NACK via other means. since the summary feedback does not
mandate the forwarding of NACK downstream. The Third Party Loss Report
can be generated at the distribution source when downstream loss is
told (e.g., downstream loss report is received), which indicates to the
receivers that they should not transmit feedback messages for the same
loss event for a certain time. Therefore the distribution source in the
feedback summary model can be reasonably certain that it will help the
situation by sending this Third Party Loss Report message to all the
relevant receivers impacted by the packet loss.

6.2. Unicast based Rapid Acquisition of Multicast Stream (RAMS) use case

The typical RAMS architecture [RFC6285] may have several Burst/ Retransmission Sources(BRS) behind the multicast source (MS) placed at the same level. These BRSes will receive the primary multicast RTP stream from the media source and cache most recent packets after joining multicast session. If packet loss happens at the upstream of all the BRSs or the downstream of one or more BRSes. one of the BRSes or all the BRSes may send a NACK or TPLR message to the DS, where the SSRC in this NACK or TPLR message is the one of the BRS. The DS forwards/reflects this message down on the primary SSM. The details on how DS deal with this message is specified in [RETRANSMISSION-FOR-SSM].

6.3. RTP transport translator use case

A Transport Translator (Topo-Trn-Translator), as defined in [RFC5117] is typically forwarding the RTP and RTCP traffic between RTP clients, for example converting between multicast and unicast for domains that do not support multicast. The translator acting as quality monitoring [Monarch] may suffer a loss of important video packets. In this case, the translator may trigger repair by the media sender and at the same time,use it's own SSRC as packet sender SSRC to create a new Third Party Loss Report message and send it to the receivers that is not aware of packet loss.

6.4. Multipoint Control Unit (MCU) use case

When the speaker is changed in a voice-activated multipoint video switching conference [RFC4587], an RTP mixer can be used to select the available input streams and forward them to each participants. If the MCU is doing a blind switch without waiting for a synchronization point on the new stream it can send a FIR to the new video source. In this case the MCU should send a FIR suppression message to the new receivers. e.g.,when the RTP Mixer starts to receive FIR from some participants it can suppress the remaining session participants from sending FIR by sending out a Third party Loss report message.

6.5. Mixer use Case

A Mixer, in accordance with [RFC5117], aggregates multiple RTP streams from other session participants and generates a new RTP stream sent to the session participants. In some cases, the video frames may get badly screwed up between media source and the mixer. In such case, the mixer need to check if the packet loss will result in PLI or FIR transmissions from most of the group by analyzing the received video. If so the mixer initiates FIR or PLI towards the media source on behalf of all the session participants and send out a Third party Loss report message to these session participants that may or are expected to send

a PLI or FIR Another possible way for mixer to deal with, is when the mixer starts to receive FIR or PLI from some participants and like to suppress the remaining session participants from sending FIR or PLI by sending out a Third party Loss report message.

7. Security Considerations

The defined messages have certain properties that have security implications. These must be addressed and taken into account by users of this protocol.
Spoofed or maliciously created feedback messages of the type defined in this specification can have the following implications:
Sending the spurious Third Party Loss Report (e.g., the Third Party Loss Report with the wrong sequence number of lost packet) that makes missing RTP packets can not be compensated.
To prevent these attacks, there is a need to apply authentication and integrity protection of the feedback messages. This can be accomplished against threats external to the current RTP session using the RTP profile that combines Secure RTP [RFC3711] and AVPF into SAVPF [RFC5124].
Note that middleboxes that are not visible at the RTP layer that wish to send the Third Party Loss Reports on behalf of the media source can only do so if they spoof the SSRC of the media source. This is difficult in case SRTP is in use. If the middlebox is visible at the RTP layer, this is not an issue, provided the middlebox is part of the security context for the session.
Also note that endpoints that receive a Third Party Loss Report would be well-advised to ignore it, unless the security is in place to authenticate the sender of the Third Party Loss Report. Accepting Third Party Loss Report from un-authenticated sender can lead to a denial of service attack, where the endpoint accepts poor quality media that could be repaired.

8. IANA Consideration

```
   Value name:        tplr
   Long Name:         Third Party Loss Reports
   Reference:         This document
```

The new value "TPLR" has been registered with IANA in the "rtcp-fb" Attribute Values registry located at the time of publication at: http://www.iana.org/assignments/sdp-parameters
A new registry " Third Party Loss Report Messages" has been created to hold "tplr" parameters located at time of publication at: http://www.iana.org/assignments/sdp-parameters
New registration in this registry follows the "Specification required" policy as defined by [RFC2434]. In addition, they are required to indicate any additional RTCP feedback types, such as "nack" and "ack".

```
   RTPFB range
   Name            Long Name                         Value  Reference
   -------------- ------------------------------- ----- ---------
   TLLEI          Transport Layer Third Party        X    [RFCXXXX]
                  Loss Early Indication
```

The following values have been registered as FMT values in the "FMT
Values for RTPFB Payload Types" registry located at the time of
publication at: http://www.iana.org/assignments/rtp-parameters

```
   PSFB range
   Name            Long Name                           Value  Reference
   -------------- -------------------------------     ----- ---------
   PSLEI          Payload Specific Third Party           X    [RFCXXXX]
                  Loss Early Indication
```

The following values have been registered as FMT values in the "FMT
Values for PSFB Payload Types" registry located at the time of
publication at: http://www.iana.org/assignments/rtp-parameters

9. Acknowledgement

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suggestions on this document.

10. References

10.1. Normative References

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[RFC2119]	Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
[RFC4585]	Ott, J., Wenger, S., Sato, N., Burmeister, C. and J. Rey, "Extended RTP Profile for Real-time Transport Control Protocol (RTCP)-Based Feedback (RTP/AVPF)", RFC 4585, July 2006.
[RFC3550]	Schulzrinne, H., Casner, S., Frederick, R. and V. Jacobson, "RTP: A Transport Protocol for Real-Time Applications", STD 64, RFC 3550, July 2003.
[RFC4588]	Rey, J., Leon, D., Miyazaki, A., Varsa, V. and R. Hakenberg, "RTP Retransmission Payload Format", RFC 4588, July 2006.
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[RFC3711]	Baugher, M., McGrew, D., Naslund, M., Carrara, E. and K. Norrman, "The Secure Real-time Transport Protocol (SRTP)", RFC 3711, March 2004.
[RFC5124]	Ott, J. and E. Carrara, "Extended Secure RTP Profile for Real-time Transport Control Protocol (RTCP)-Based Feedback (RTP/SAVPF)", RFC 5124, February 2008.

10.2. Informative References

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[DVB-IPTV]	ETSI Standard, "Digital Video Broadcasting(DVB); Transport of MPEG-2 TS Based DVB Services over IP Based Networks", ETSI TS 102 034, V1.4.1 , August 2009.
[RFC6285]	Steeg, B., Begen, A., Caenegem, T. and Z. Vax, "Unicast- Based Rapid Acquisition of Multicast RTP Sessions", June 2011.
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[RETRANSMISSION-FOR-SSM]	Caenegem, T., Steeg, B. and A. Begen, "Retransmission for Source-Specific Multicast (SSM) Sessions", May 2011.
[RFC5117]	Westerlund, M. and S. Wenger, "RTP Topologies", RFC 5117, January 2008.
[RFC4587]	Even, R., "RTP Payload Format for H.261 Video Streams", RFC 4587, August 2006.

Appendix A. Change Log

Note to the RFC-Editor: please remove this section prior to publication as an RFC.

Appendix A.1. draft-ietf-avtcore-feedback-suppression-rtp-01

The following are the major changes compared to previous version:

  *Remove the merge report from SSM use case and additional text to address report merging issue.

*Revise section 3 and section 6 to address FEC packet dealing
 issue and Leave how to repair packet loss beyond the scope.

*Modify the SSM use case and RAMS use case to focus on uses.

*Other Editorial changes.

Appendix A.2. draft-ietf-avtcore-feedback-suppression-rtp-02

The following are the major changes compared to previous version:

*In Section 4.1, fix typo: Section 4.3.1.1 of section [RFC5104]->
 section 6.2.1 of [RFC4585].

*In Section 3: Clarify how to deal with downstream loss using
 Third party loss report and upstream loss using NACK.

*Update title and abstract to focus on third party loss report.

*In Section 6.1: Update this section to explain how third party
 loss report is used to deal with downstream loss.

*In section 6.1.2: Update this section to explain how third party
 loss report is used to deal with downstream loss.

*In section 6.2: Rephrase the text to discuss how BRS deal with
 the third party loss report.

Appendix A.3. draft-ietf-avtcore-feedback-suppression-rtp-03

The following are the major changes compared to previous version:

*In Appendix A, fix typo: Appendix A. Appendix A. -> Appendix A.

*Update abstract to clarify when third-party loss reports should
 be sent instead of NACKs.

*Update section 3 Paragraph 2 to differentiate when a third-party
 loss report should be used compared to a NACK.

*Update section 3 Paragraph 3 to explain when media source to send
    a third-party loss.

   *Move specific rules for section 6.1.1 and section 6.1.2 to
    section 6.1 as generic rules and delete section 6.1.1.

Appendix A.4. draft-ietf-avtcore-feedback-suppression-rtp-04

The following are the major changes compared to previous version:

   *Reference Update.

   *Clarify the use of the third party loss report in section 3 and
    section 6.1.1.

Appendix A.5. draft-ietf-avtcore-feedback-suppression-rtp-05

The following are the major changes compared to previous version:

   *Remove 3rd and 4th paragraphs of section 6.1 and replaced them
    with 2nd and 3rd paragraphs of section 3.

   *Remove section 6.1.1.1.

   *Revise the last paragraph of section 1 to clarify the rationale
    of using new message.

   *Update RTP transport translator case in section 6.3 to correct
    the use of the third party loss report.

   *Update MCU case in section 6.4 to correct the use of the third
    party loss report.

   *Revise SSM use case to address multiple DS issue.

   *References Update.

   *Move one rationale on preventing sending unicast NACK in
    introduction section to SSM case section.

   *Other Editorial changes to section 6.1, 6.1.1, 6.2.

Appendix A.6. draft-ietf-avtcore-feedback-suppression-rtp-06

The following are the major changes compared to previous version:

*A few Editorial changes to the whole document.

Appendix A.7. draft-ietf-avtcore-feedback-suppression-rtp-07

The following are the major changes compared to previous version:

*Restructuring the protocol overview section to clarify the round
 trip time calculation and receiver behavior to the additional
 TPLR.

*Restructuring the SSM use case section to focus on the use of
 TPLR.

*Editorial changes to the abstract, introduction, message format,
 use cases and IANA sections.

*References update

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