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Duplication Grouping Semantics in the Session Description Protocol

Abstract

Packet loss is undesirable for real-time multimedia sessions, but it can occur due to congestion or other unplanned network outages. This is especially true for IP multicast networks, where packet loss patterns can vary greatly between receivers. One technique that can be used to recover from packet loss without incurring unbounded delay for all the receivers is to duplicate the packets and send them in separate redundant streams. This document defines the semantics for grouping redundant streams in the Session Description Protocol (SDP). The semantics defined in this document are to be used with the SDP Grouping Framework. Grouping semantics at the Synchronization Source (SSRC) level are also defined in this document for RTP streams using SSRC multiplexing.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc7104.

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1. Introduction

The Real-time Transport Protocol (RTP) [RFC3550] is widely used today for delivering IPTV traffic and other real-time multimedia sessions. Many of these applications support very large numbers of receivers and rely on intra-domain UDP/IP multicast for efficient distribution of traffic within the network.

While this combination has proved successful, there does exist a weakness. As [RFC2354] noted, packet loss is not avoidable, even in a carefully managed network. This loss might be due to congestion; it might also be a result of an unplanned outage caused by a flapping link, a link or interface failure, a software bug, or a maintenance person accidentally cutting the wrong fiber. Since UDP/IP flows do not provide any means for detecting loss and retransmitting packets, it is left up to the RTP layer and the applications to detect, and recover from, packet loss.

One technique to recover from packet loss without incurring unbounded delay for all the receivers is to duplicate the packets and send them in separate redundant streams. Variations on this idea have been implemented and deployed today [IC2011]. [RTP-DUP] explains how duplication can be achieved for RTP streams without breaking the RTP and RTP Control Protocol (RTCP) functionality. In this document, we describe the semantics needed in the Session Description Protocol (SDP) [RFC4566] to support this technique.

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].

3. Duplication Grouping

3.1. "DUP" Grouping Semantics

Each "a=group" line is used to indicate an association relationship between the redundant streams. The streams included in one "a=group" line are called a "Duplication Group".

Using the SDP Grouping Framework in [RFC5888], this document defines "DUP" as the grouping semantics for redundant streams.

The "a=group:DUP" semantics MUST be used to group the redundant streams, except when the streams are specified in the same media description, i.e., in the same "m" line (see Section 3.2). In an "a=group:DUP" line, the order of the listed redundant streams does not strictly indicate the order of transmission, although it is RECOMMENDED that the stream listed first be sent first, with the other stream(s) being the (time-delayed) duplicate(s).

3.2. Duplication Grouping for SSRC-Multiplexed RTP Streams

[RFC5576] defines an SDP media-level attribute, called "ssrc-group", for grouping the RTP streams that are SSRC multiplexed and carried in the same RTP session. The grouping is based on the SSRC identifiers. Since SSRC-multiplexed RTP streams are defined in the same "m" line, the "group" attribute cannot be used.

This section explains how duplication is used with SSRC-multiplexed streams using the "ssrc-group" attribute [RFC5576].

The semantics of "DUP" for the "ssrc-group" attribute are the same as the one defined for the "group" attribute, except that the SSRC identifiers are used to designate the duplication grouping associations: a=ssrc-group:DUP *(SP ssrc-id) [RFC5576]. As above, while in an "a=ssrc-group:DUP" line, the order of the listed redundant streams does not necessarily indicate the order of transmission, but it is RECOMMENDED that the stream listed first be sent first, with the other stream(s) being the (time-delayed) duplicate(s).

3.3. SDP Offer/Answer Model Considerations

When offering duplication grouping using SDP in an offer/answer model [RFC3264], the following considerations apply.

A node that is receiving an offer from a sender may or may not understand line grouping. It is also possible that the node understands line grouping but does not understand the "DUP" semantics. From the viewpoint of the sender of the offer, these cases are indistinguishable.

When a node is offered a session with the "DUP" grouping semantics but it does not support line grouping or the duplication grouping semantics, as per [RFC5888], the node responds to the offer either (1) with an answer that omits the grouping attribute or (2) with a refusal to the request (e.g., "488 Not Acceptable Here" or "606 Not Acceptable in SIP").

In the first case, the original sender of the offer must send a new offer without any duplication grouping. In the second case, if the sender of the offer still wishes to establish the session, it should retry the request with an offer without the duplication grouping. This behavior is specified in [RFC5888].

4. SDP Examples

4.1. Separate Source Addresses

In this example, the redundant streams use the same IP destination address (232.252.0.1), but they are sourced from different addresses (198.51.100.1 and 198.51.100.2). Thus, the receiving host needs to join both source-specific multicast (SSM) sessions separately.

```
v=0
o=ali 1122334455 1122334466 IN IP4 dup.example.com
s=DUP Grouping Semantics
t=0 0
m=video 30000 RTP/AVP 100
c=IN IP4 233.252.0.1/127
a=source-filter:incl IN IP4 233.252.0.1 198.51.100.1 198.51.100.2
a=rtpmap:100 MP2T/90000
a=ssrc:1000 cname:ch1@example.com
a=ssrc:1010 cname:ch1@example.com
a=ssrc-group:DUP 1000 1010
a=mid:Ch1
```

Note that in actual use, SSRC values, which are random 32-bit numbers, can be much larger than the ones shown in this example. Also, note that this SDP description does not use the "duplication-delay" attribute (defined in [DELAYED-DUP]) since the sender does not apply any delay between the redundant streams upon transmission. Alternatively, one MAY explicitly insert an "a=duplication-delay:0" line before the "a=mid:Ch1" line for informational purposes.

4.2. Separate Destination Addresses

In this example, the redundant streams have different IP destination addresses. The example shows the same UDP port number and IP source address for each stream, but either or both could have been different for the two streams.

```
v=0
o=ali 1122334455 1122334466 IN IP4 dup.example.com
s=DUP Grouping Semantics
t=0 0
a=group:DUP S1a S1b
m=video 30000 RTP/AVP 100
c=IN IP4 233.252.0.1/127
a=source-filter:incl IN IP4 233.252.0.1 198.51.100.1
a=rtpmap:100 MP2T/90000
a=mid:S1a
m=video 30000 RTP/AVP 101
c=IN IP4 233.252.0.2/127
a=source-filter:incl IN IP4 233.252.0.2 198.51.100.1
a=rtpmap:101 MP2T/90000
a=mid:S1b
```

Optionally, one could be more explicit and insert an "a=duplication-delay:0" line before the first "m" line.

4.3. Temporal Redundancy

In this example, the redundant streams have the same IP source and destination addresses (i.e., they are transmitted in the same SSM session). Due to the same source and destination addresses, the packets in both streams will be routed over the same path. To provide resiliency against packet loss, the duplicate of an original packet is transmitted 50 milliseconds (ms) later as indicated by the "duplication-delay" attribute (defined in [DELAYED-DUP]).

```
v=0
o=ali 1122334455 1122334466 IN IP4 dup.example.com
s=Delayed Duplication
t=0 0
m=video 30000 RTP/AVP 100
c=IN IP4 233.252.0.1/127
a=source-filter:incl IN IP4 233.252.0.1 198.51.100.1
a=rtpmap:100 MP2T/90000
a=ssrc:1000 cname:ch1a@example.com
a=ssrc:1010 cname:ch1a@example.com
a=ssrc-group:DUP 1000 1010
a=duplication-delay:50
a=mid:Ch1
```

5. Security Considerations

In general, the security considerations of [RFC4566] apply to this document as well.

There is a weak threat for the receiver that the duplication grouping can be modified to indicate relationships that do not exist. Such attacks might result in failure of the duplication mechanisms and/or mishandling of the media streams by the receivers.

In order to avoid attacks of this sort, the SDP description needs to be integrity protected and provided with source authentication. This can, for example, be achieved on an end-to-end basis using S/MIME [RFC5652] [RFC5751] when the SDP is used in a signaling packet using MIME types (application/sdp). Alternatively, HTTPS [RFC2818] or the authentication method in the Session Announcement Protocol (SAP) [RFC2974] could be used as well. As for the confidentiality, if it is desired, it can be useful to use a secure, encrypted transport method to carry the SDP description.

6. IANA Considerations

This document registers the following semantics with IANA in the "Semantics for the "group" SDP Attribute" subregistry (under the "Session Description Protocol (SDP) Parameters" registry:

Semantics	Token	Reference
Duplication	DUP	[RFC7104]

This document also registers the following semantics with IANA in the "Semantics for the "ssrc-group" SDP Attribute" subregistry under the "Session Description Protocol (SDP) Parameters" registry:

Token	Semantics	Reference
DUP	Duplication	[RFC7104]

7. Acknowledgments

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8. References

8.1. Normative References

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8.2. Informative References

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