A Framework for SDP Attributes when Multiplexing
draft-ietf-mmusic-sdp-mux-attributes-14

Abstract

   The purpose of this specification is to provide a framework for
   analyzing the multiplexing characteristics of Session Description
   Protocol (SDP) attributes when SDP is used to negotiate the usage of
   single 5-tuple for sending and receiving media associated with
   multiple media descriptions.

   This specification also categorizes the existing SDP attributes based
   on the framework described herein.

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Table of Contents

1. Introduction

   SDP defines several attributes for capturing characteristics that
   apply to the individual media descriptions (described by "m=" lines")
   and the overall multimedia session. Typically different media types
   (audio, video, etc.) described using different media descriptions
   represent separate RTP sessions that are carried over individual
   transport layer flows. However
   [I-D.ietf-mmusic-sdp-bundle-negotiation] defines a way to use a
   single address:port combination (BUNDLE address) for receiving media
   associated with multiple SDP media descriptions. This would, for
   example allow the usage of a single set of Interactive Connectivity
   Establishment (ICE) [RFC5245] candidates for multiple media
   descriptions. This in turn has made it necessary to understand the
   interpretation and usage of the SDP attributes defined for the
   multiplexed media descriptions.

   Given the number of SDP attributes registered with the [IANA] and
   possibility of new attributes being defined in the future, there is
   need for a framework to analyze these attributes for their
   applicability in the transport multiplexing use-cases.

   The document starts with providing the motivation for requiring such
   a framework. This is followed by introduction to the SDP attribute
   analysis framework/procedures, following which several sections apply
   the framework to the SDP attributes registered with the [IANA].

2. Terminology

   5-tuple: A collection of the following values: source address, source
   port, destination address, destination port, and transport-layer
   protocol.

   3GPP: Third Generation Partnership Project; see http://www.3gpp.org
   for more information about this organization.

   The key words "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. Motivation

The time and complications of setting up ICE [RFC5245] and Datagram
Transport Layer Security (DTLS) based Secure Real-time Transport
Protocol (SRTP) [RFC5763] transports for use by RTP, reasons to
conserve ports bindings on the Network Address Translators (NAT),
forms a requirement to try and reduce the number of transport level
flows needed. This has resulted in the definition of ways, such as
[I-D.ietf-mmusic-sdp-bundle-negotiation] to multiplex RTP over a
single transport flow in order to preserve network resources such as
port numbers. This imposes further restrictions on applicability of
the SDP attributes as they are defined today.

The specific problem is that there are attribute combinations which
make sense when specified on independent "m=" lines -- as with
classical SDP -- that do not make sense when those "m=" lines are
then multiplexed over the same transport. To give an obvious
example, ICE permits each "m=" line to have an independently
specified ice-ufrag attribute. However, if the media from multiple
"m=" lines is multiplexed over the same ICE component, then the
meaning of media-level ice-ufrag attributes becomes muddled.

At the time of writing this document there are close to 250 SDP
attributes registered with the [IANA] and more will be added in the
future. There is no clearly defined procedure to establish the
validity/applicability of these attributes when used with transport
multiplexing.

4. SDP Attribute Analysis Framework

Attributes in an SDP session description can be defined at the
session-level or media-level or source-level. Informally, there are
various semantic groupings for these attributes. One such grouping
could be notes as below:

o Attributes related to media content such as media type, encoding
   schemes and payload types.

o Attributes specifying media transport characteristics like RTP/RTP
   Control Protocol (RTCP) port numbers, network addresses and QOS.

o Metadata description attributes capturing session timing and
   origin information.

o Attributes establishing relationships between media descriptions
   such as grouping framework [RFC5888]

The proposed framework analyzes the SDP attributes usage under
multiplexing and assigns each SDP attribute to an appropriate
multiplexing category. Since the multiplexing categories defined in
this specification are independent of any informal semantic groupings
of the SDP attributes, the categorizations assigned are normative.

4.1. Category: NORMAL

The attributes in the NORMAL category can be independently specified
when multiplexed and they retain their original semantics.

In the example given below, the direction and label attributes are
independently specified for audio and video "m=" lines. These
attributes are not impacted by multiplexing these media streams over
a single transport layer flow.

```
v=0
o=alice 2890844526 2890844527 IN IP4 host.atlanta.example.com
s=
c=IN IP4 host.atlanta.example.com
t=0 0
m=audio 49172 RTP/AVP 99
a=sendonly
a=label:1
a=rtpmap:99 iLBC/8000
m=video 49172 RTP/AVP 31
a=recvonly
a=label:2
a=rtpmap:31 H261/90000
```

4.2. Category: CAUTION

The attributes in the CAUTION category are advised against
multiplexing since their usage under multiplexing might lead to
incorrect behavior.

Example: Multiplexing media descriptions over a single Datagram
Congestion Control Protocol (DCCP) transport [RFC5762] is not
recommended since DCCP being a connection oriented protocol doesn't
allow multiple connections on the same 5-tuple.

```
v=0
o=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=
c=IN IP4 client.biloxi.example.com
t=0 0
m=video 5004 DCCP/RTP/AVP 99
a=rtpmap:99 h261/9000
a=dccp-service-code:SC=x52545056
a=setup:passive
a=connection:new
m=video 5004 DCCP/RTP/AVP 100
a=rtpmap:100 h261/9000
a=dccp-service-code:SC=x5254504f
a=setup:passive
a=connection:new
```

4.3. Category: IDENTICAL

The attributes and their associated values (if any) in the IDENTICAL
category MUST be repeated across all the media descriptions under
multiplexing.

Attributes such as rtcp-mux fall into this category. Since RTCP
reporting is done per RTP session, RTCP Multiplexing MUST be enabled
for both the audio and video "m=" lines if they are transported over
a single 5-tuple.

```
v=0
o=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=
c=IN IP4 client.biloxi.example.com
t=0 0
m=audio 34567 RTP/AVP 97
a=rtcp-mux
m=video 34567 RTP/AVP 31
a=rtpmap:31 H261/90000
a=rtcp-mux
```

4.4. Category: SUM

The attributes in the SUM category can be set as they are normally
used but software using them in the multiplexing scenario MUST apply
the sum of all the attributes being multiplexed instead of trying to
use them independently. This is typically used for bandwidth or
other rate limiting attributes to the underlying transport.

The software parsing the SDP sample below, should use the aggregate
Application Specific (AS) bandwidth value from the individual media

descriptions to determine the AS value for the multiplexed session.
Thus the calculated AS value would be 256+64 kilobits per second for
the given example.

```
v=0
o=test 2890844526 2890842807 IN IP4 client.biloxi.example.com
c=IN IP4 client.biloxi.example.com
t=0 0
m=audio 49170 RTP/AVP 0
b=AS:64
m=video 51372 RTP/AVP 31
b=AS:256
```

4.5. Category: TRANSPORT

The attributes in the TRANSPORT category can be set normally for
multiple items in a multiplexed group but the software MUST pick the
one that's associated with the "m=" line whose information is used
for setting up the underlying transport.

In the example below, "a=crypto" attribute is defined for both the
audio and the video "m=" lines. The video media line's a=crypto
attribute is chosen since its mid value (bar) appears first in the
a=group:BUNDLE line. This is due to BUNDLE grouping semantic
[I-D.ietf-mmusic-sdp-bundle-negotiation] which mandates the values
from "m=" line corresponding to the mid appearing first on the
a=group:BUNDLE line to be considered for setting up the RTP
Transport.

```
v=0
o=alice 2890844526 2890844527 IN IP4 host.atlanta.example.com
s=
c=IN IP4 host.atlanta.example.com
t=0 0
a=group:BUNDLE bar foo
m=audio 49172 RTP/AVP 99
a=mid:foo
a=crypto:1 AES_CM_128_HMAC_SHA1_80
  inline:d0RmdmcmVCspeEc3QGZiNWpVLFJhQX1cfHAwJSoj|2^20|1:32
a=rtpmap:99 iLBC/8000
m=video 51374 RTP/AVP 31
a=mid:bar
a=crypto:1 AES_CM_128_HMAC_SHA1_80
  inline:EcGZiNWpFJhQXdspcl1ekcmVCNWpVLcfHAwJSoj|2^20|1:32
a=rtpmap:96 H261/90000
```

4.6. Category: INHERIT

   The attributes in the INHERIT category encapsulate other SDP
   attributes or parameters. These attributes inherit their
   multiplexing characteristics from the attributes or parameters they
   encapsulate. Such attributes are defined in [RFC3407], [RFC5939] and
   [RFC6871] as part of a generic framework for indicating and
   negotiating transport, media, and media format related capabilities
   in the SDP.

   The inheritance manifests itself when the encapsulated attribute or
   parameter is being leveraged. In the case of SDP Capability
   Negotiation [RFC5939] for example, this occurs when a capability
   (encapsulating attribute) is used as part of a configuration; the
   configuration inherits the multiplexing category of each of its
   constituent (encapsulated) attributes and parameters. The inherited
   attributes MUST be coherent in order to form a valid configuration
   from a multiplexing point of view (see Section 14 for further
   details).

```
        v=0
        o=alice 2890844526 2890844527 IN IP4 host.atlanta.example.com
        s=
        c=IN IP4 host.atlanta.example.com
        t=0 0
        m=video 3456 RTP/AVP 100
        a=rtpmap:100 VP8/90000
        a=fmtp:100 max-fr=30;max-fs=8040
        a=sqn: 0
        a=cdsc: 1 video RTP/AVP 100
        a=cpar: a=rtcp-mux
        m=video 3456 RTP/AVP 101
        a=rtpmap:101 VP8/90000
        a=fmtp:100 max-fr=15;max-fs=1200
        a=cdsc: 2 video RTP/AVP 101
        a=cpar: a=rtcp-mux
```

   In the above example, the category IDENTICAL is inherited by the cpar
   encapsulated rtcp-mux attribute.

4.7. Category: IDENTICAL-PER-PT

   The attributes in the IDENTICAL-PER-PT category define the RTP
   payload configuration on per Payload Type basis and MUST have
   identical values across all the media descriptions for a given RTP
   Payload Type when repeated. These Payload Types identify the same
   codec configuration as defined in the Section 10.1.2 of
   [I-D.ietf-mmusic-sdp-bundle-negotiation] under this context.

In the SDP example below, Payload Types 96 and 97 are repeated across
all the video "m=" lines and all the payload specific parameters (ex:
rtpmap, fmtp) are identical (Note: some line breaks included are due
to formatting only).


```
v=0
o=alice 2890844526 2890844527 IN IP4 host.atlanta.example.com
s=
c=IN IP4 host.atlanta.example.com
t=0 0
a=group:BUNDLE cam1 cam2
m=video 96 97
a=mid:cam1
a=rtpmap:96 H264/90000
a=fmtp:96 profile-level-id=42400d; max-fs=3600; max-fps=3000;
max-mbps=108000; max-br=1000
a=rtpmap:97 H264/90000
a=fmtp:97 profile-level-id=42400a; max-fs=240; max-fps=3000;
max-mbps=7200; max-br=200
m=video  96 97
a=mid:cam2
a=rtpmap:96 H264/90000
a=fmtp:96 profile-level-id=42400d; max-fs=3600; max-fps=3000;
max-mbps=108000; max-br=1000
a=rtpmap:97 H264/90000
a=fmtp:97 profile-level-id=42400a; max-fs=240; max-fps=3000;
max-mbps=7200; max-br=200
```

4.8. Category: SPECIAL

For the attributes in the SPECIAL category, the text in the
specification defining the attribute MUST be consulted for further
handling when multiplexed.

As an exampe, for the attribute extmap [RFC5285], the specification
defining the extension needs to be referred to understand the
multiplexing implications.

4.9. Category: TBD

The attributes in the TBD category have not been analyzed under the
proposed multiplexing framework and SHOULD NOT be multiplexed.

5. Analysis of Existing Attributes

   This section analyzes attributes listed in [IANA], grouped under the
   IETF document that defines them.

   The "Level" column indicates whether the attribute is currently
   specified as:

   o S -- Session level

   o M -- Media level

   o B -- Both

   o SR -- Source-level (for a single SSRC) [RFC5576]

   The "Mux Category" column identifies multiplexing category assigned
   per attribute and the "Notes" column captures additional informative
   details regarding the assigned category, wherever necessary.

5.1. RFC4566: SDP

   [RFC4566] defines SDP that is intended for describing multimedia
   sessions for the purposes of session announcement, session
   invitation, and other forms of multimedia session initiation.

```
   +-----------------+---------------------+-------+------------------+
   | Name            | Notes               | Level | Mux Category     |
   +-----------------+---------------------+-------+------------------+
   | sendrecv        | Not impacted        | B     | NORMAL           |
   |                 |                     |       |                  |
   | sendonly        | Not impacted        | B     | NORMAL           |
   |                 |                     |       |                  |
   | recvonly        | Not impacted        | B     | NORMAL           |
   |                 |                     |       |                  |
   | inactive        | Not impacted        | B     | NORMAL           |
   |                 |                     |       |                  |
   | cat             | Not impacted        | S     | NORMAL           |
   |                 |                     |       |                  |
   | ptime           | The attribute value | M     | IDENTICAL-PER-PT |
   |                 | MUST be same for a  |       |                  |
   |                 | given codec         |       |                  |
   |                 | configuration       |       |                  |
   |                 |                     |       |                  |
   | maxptime        | The attribute value | M     | IDENTICAL-PER-PT |
   |                 | MUST be same for a  |       |                  |
   |                 | given codec         |       |                  |
   |                 | configuration       |       |                  |
```

orient	Not Impacted	M	NORMAL	
framerate	The attribute value MUST be same for a given codec configuration	M	IDENTICAL-PER-PT	
quality	Not Impacted	M	NORMAL	
rtpmap	The attribute value MUST be same for a given codec configuration	M	IDENTICAL-PER-PT	
fmtp	The attribute value MUST be same for a given codec configuration	M	IDENTICAL-PER-PT	
keywds	Not impacted	S	NORMAL	
type	Not Impacted	S	NORMAL	
type:broadcast	Not Impacted	S	NORMAL	
type:H332	Not Impacted	S	NORMAL	
type:meeting	Not Impacted	S	NORMAL	
type:moderated	Not Impacted	S	NORMAL	
type:test	Not Impacted	S	NORMAL	
tool	Not Impacted	S	NORMAL	
charset	Not Impacted	S	NORMAL	
sdplang	Not Impacted	B	NORMAL	
lang	Not Impacted	B	NORMAL	

5.1 RFC4566 Attribute Analysis

5.2. RFC4585: RTP/AVPF

[RFC4585] defines an extension to the Audio-visual Profile (AVP) that
enables receivers to provide, statistically, more immediate feedback
to the senders and thus allows for short-term adaptation and
efficient feedback-based repair mechanisms to be implemented.

```
+----------+---------------------------+-------+------------------+
| Name     | Notes                     | Level | Mux Category     |
+----------+---------------------------+-------+------------------+
| rtcp-fb  | Since RTCP feedback        | M     | IDENTICAL-PER-PT |
|          | attributes are Payload     |       |                  |
|          | Type (PT) scoped, their    |       |                  |
|          | values MUST be identical   |       |                  |
|          | for a given PT across the  |       |                  |
|          | multiplexed "m=" lines.    |       |                  |
|          |                            |       |                  |
+----------+---------------------------+-------+------------------+
```

                  5.2 RFC4585 Attribute Analysis

5.3. RFC5761: Multiplexing RTP and RTCP

[RFC5761] discusses issues that arise when multiplexing RTP data
packets and RTP Control Protocol (RTCP) packets on a single UDP port.
It describes when such multiplexing is and is not appropriate, and it
explains how the SDP can be used to signal multiplexed sessions.

```
+-----------+--------------------------------+-------+------------+
| Name      | Notes                          | Level | Mux        |
|           |                                |       | Category   |
+-----------+--------------------------------+-------+------------+
| rtcp-mux  | RTP and RTCP Multiplexing      | M     | IDENTICAL  |
|           | affects the entire RTP session |       |            |
|           |                                |       |            |
+-----------+--------------------------------+-------+------------+
```

                  5.3 RFC5761 Attribute Analysis

5.4. RFC3312: Integration of Resource Management and SIP

[RFC3312] defines a generic framework for preconditions, which are
extensible through IANA registration. This document also discusses
how network quality of service can be made a precondition for
establishment of sessions initiated by the Session Initiation
Protocol (SIP). These preconditions require that the participant
reserve network resources before continuing with the session.

```
+-------+----------------------+-------+--------------+
| Name  | Notes                | Level | Mux Category |
+-------+----------------------+-------+--------------+
| des   | Refer to notes below | M     | CAUTION      |
|       |                      |       |              |
| conf  | Refer to notes below | M     | CAUTION      |
|       |                      |       |              |
| curr  | Refer to notes below | M     | CAUTION      |
|       |                      |       |              |
+-------+----------------------+-------+--------------+
```

5.4 RFC3312 Attribute Analysis

NOTE: A mismatched set of preconditions across media descriptions
results in Session establishment failures due to inability to meet
right resource reservations requested.

5.5. RFC4574: SDP Label Attribute

[RFC4574] defines a new SDP media-level attribute: "label". The
"label" attribute carries a pointer to a media stream in the context
of an arbitrary network application that uses SDP. The sender of the
SDP document can attach the "label" attribute to a particular media
stream or streams. The application can then use the provided pointer
to refer to each particular media stream in its context.

```
+--------+---------------+-------+--------------+
| Name   | Notes         | Level | Mux Category |
+--------+---------------+-------+--------------+
| label  | Not Impacted  | M     | NORMAL       |
|        |               |       |              |
+--------+---------------+-------+--------------+
```

5.5 RFC4574 Attribute Analysis

5.6. RFC5432: QOS Mechanism Selection in SDP

[RFC5432] defines procedures to negotiate QOS mechanisms using the
SDP offer/answer model.

```
+---------------+----------------------+-------+-------------+
| Name          | Notes                | Level | Mux Category |
+---------------+----------------------+-------+-------------+
| qos-mech-send | Refer to Section 10  | B     | TRANSPORT   |
|               |                      |       |             |
| qos-mech-recv | Refer to Section 10  | B     | TRANSPORT   |
|               |                      |       |             |
+---------------+----------------------+-------+-------------+
```

                    5.6 RFC5432 Attribute Analysis

5.7. RFC4568: SDP Security Descriptions

   [RFC4568] defines a SDP cryptographic attribute for unicast media
   streams. The attribute describes a cryptographic key and other
   parameters that serve to configure security for a unicast media
   stream in either a single message or a roundtrip exchange.

```
+---------+------------------------------------+-------+------------+
| Name    | Notes                              | Level | Mux        |
|         |                                    |       | Category   |
+---------+------------------------------------+-------+------------+
| crypto  | crypto attribute MUST be the one   | M     | TRANSPORT  |
|         | that corresponds to the "m=" line  |       |            |
|         | chosen for setting up the          |       |            |
|         | underlying transport flow          |       |            |
|         |                                    |       |            |
+---------+------------------------------------+-------+------------+
```

                    5.7 RFC4568 Attribute Analysis

5.8. RFC5762: RTP over DCCP

   RTP is a widely used transport for real-time multimedia on IP
   networks. DCCP is a transport protocol that provides desirable
   services for real-time applications. [RFC5762] specifies a mapping
   of RTP onto DCCP, along with associated signaling, such that real-
   time applications can make use of the services provided by DCCP.

```
+-------------------+------------------------+---------+----------+
| Name              | Notes                  | Current | Mux      |
|                   |                        |         | Category |
+-------------------+------------------------+---------+----------+
| dccp-service-code | If RFC6773 is not being| M       | CAUTION  |
|                   | used in addition to    |         |          |
|                   | RFC5762, the port in   |         |          |
|                   | the "m=" line is a DCCP|         |          |
|                   | port. DCCP being a     |         |          |
|                   | connection oriented    |         |          |
|                   | protocol does not allow|         |          |
|                   | multiple connections on|         |          |
|                   | the same 5-tuple       |         |          |
|                   |                        |         |          |
+-------------------+------------------------+---------+----------+
```

<center>5.8 RFC5762 Attribute Analysis</center>

NOTE: If RFC6773 is being used in addition to RFC5762 and provided
that DCCP-in-UDP layer has additional demultiplexing, then it can be
possible to use different DCCP service codes for each DCCP flow,
given each uses a different DCCP port. Although doing so might
conflict with the media type of the "m=" line. None of this is
standardized yet and it wouldn't work as explained. Hence performing
multiplexing is not recommended even in this alternate scenario.

5.9. RFC6773: DCCP-UDP Encapsulation

[RFC6773] specifies an alternative encapsulation of DCCP, referred to
as DCCP-UDP. This encapsulation allows DCCP to be carried through
the current generation of Network Address Translation (NAT) middle
boxes without modification of those middle boxes.

```
+-----------+---------------------------------+-------+----------+
| Name      | Notes                           | Level | Mux      |
|           |                                 |       | Category |
+-----------+---------------------------------+-------+----------+
| dccp-port | Multiplexing is not recommended | M     | CAUTION  |
|           | due to potential conflict between|      |          |
|           | the port used for DCCP          |       |          |
|           | en/decapsulation and the RTP    |       |          |
|           |                                 |       |          |
+-----------+---------------------------------+-------+----------+
```

<center>5.9 RFC6773 Attribute Analysis</center>

NOTE: RFC6773 is about tunneling DCCP in UDP, with the UDP port being
the port of the DCCP en-/de-capsulation service. This encapsulation

allows arbitrary DCCP packets to be encapsulated and the DCCP port
chosen can conflict with the port chosen for the RTP traffic. For
multiplexing several DCCP-in-UDP encapsulations on the same UDP port
with no RTP traffic on the same port implies collapsing several DCCP
port spaces together. This can or cannot work depending on the
nature of DCCP encapsulation and ports choices thus rendering it to
be very application dependent.

5.10. RFC5506: Reduced-Size RTCP in RTP Profile

[RFC5506] discusses benefits and issues that arise when allowing RTCP
packets to be transmitted with reduced size.

```
+-------------+------------------------------+-------+------------+
| Name        | Notes                        | Level | Mux        |
|             |                              |       | Category   |
+-------------+------------------------------+-------+------------+
| rtcp-rsize  | Reduced size RTCP affects the | M    | IDENTICAL  |
|             | entire RTP session           |       |            |
|             |                              |       |            |
+-------------+------------------------------+-------+------------+
```

                   5.10 RFC5506 Attribute Analysis

5.11. RFC6787: Media Resource Control Protocol Version 2

The Media Resource Control Protocol Version 2 (MRCPv2) allows client
hosts to control media service resources such as speech synthesizers,
recognizers, verifiers, and identifiers residing in servers on the
network. MRCPv2 is not a "stand-alone" protocol -- it relies on
other protocols, such as the SIP, to coordinate MRCPv2 clients and
servers, and manage session between them, and SDP to describe,
discover, and exchange capabilities. It also depends on SIP and SDP
to establish the media sessions and associated parameters between the
media source or sink and the media server. Once this is done, the
MRCPv2 exchange operates over the control session established above,
allowing the client to control the media processing resources on the
speech resource server. [RFC6787] defines attributes for this
purpose.

```
+-----------+---------------+-------+--------------+
| Name      | Notes         | Level | Mux Category |
+-----------+---------------+-------+--------------+
| resource  | Not Impacted  | M     | NORMAL       |
|           |               |       |              |
| channel   | Not Impacted  | M     | NORMAL       |
|           |               |       |              |
| cmid      | Not Impacted  | M     | NORMAL       |
|           |               |       |              |
+-----------+---------------+-------+--------------+
```

5.11 RFC6787 Attribute Analysis

5.12. RFC5245: ICE

[RFC5245] describes a protocol for NAT traversal for UDP-based
multimedia sessions established with the offer/answer model. ICE
makes use of the Session Traversal Utilities for NAT (STUN) protocol
and its extension, Traversal Using Relay NAT (TURN). ICE can be used
by any protocol utilizing the offer/answer model, such as the SIP.

Name	Notes	Level	Mux Category
ice-lite	Not Impacted	S	NORMAL
ice-options	Not Impacted	S	NORMAL
ice-mismatch	Not Impacted	S	NORMAL
ice-pwd	ice-pwd MUST be the one that corresponds to the "m=" line chosen for setting up the underlying transport flow	B	TRANSPORT
ice-ufrag	ice-ufrag MUST be the one that corresponds to the "m=" line chosen for setting up the underlying transport flow	B	TRANSPORT
candidate	ice candidate MUST be the one that corresponds to the "m=" line chosen for setting up the underlying transport flow	M	TRANSPORT
remote-candidates	ice remote candidate MUST be the one that corresponds to the "m=" line chosen for setting up the underlying transport flow	M	TRANSPORT

5.12 RFC5245 Attribute Analysis

5.13. RFC5285: RTP Header Extensions

[RFC5285] provides a general mechanism to use the header extension
feature of RTP. It provides the option to use a small number of
small extensions in each RTP packet, where the universe of possible
extensions is large and registration is de-centralized. The actual

extensions in use in a session are signaled in the setup information
for that session.

```
+---------+------------------------------------+-------+----------+
| Name    | Notes                              | Level | Mux      |
|         |                                    |       | Category |
+---------+------------------------------------+-------+----------+
| extmap  | Refer to the document defining the | B     | SPECIAL  |
|         | specific RTP Extension             |       |          |
|         |                                    |       |          |
+---------+------------------------------------+-------+----------+
```

             5.13 [RFC5285](#) Attribute Analysis

[5.14](#). [RFC3605](#): **RTCP attribute in SDP**

Originally, SDP assumed that RTP and RTCP were carried on consecutive
ports. However, this is not always true when NATs are involved.
[[RFC3605](#)] specifies an early mechanism to indicate the RTCP port.

```
+-------+------------------------------------+-------+------------+
| Name  | Notes                              | Level | Mux        |
|       |                                    |       | Category   |
+-------+------------------------------------+-------+------------+
| rtcp  | RTCP Port MUST be the one that     | M     | TRANSPORT  |
|       | corresponds to the "m=" line chosen|       |            |
|       | for setting up the underlying      |       |            |
|       | transport flow.                    |       |            |
|       |                                    |       |            |
+-------+------------------------------------+-------+------------+
```

             5.14 [RFC3605](#) Attribute Analysis

[5.15](#). [RFC5576](#): **Source-Specific SDP Attributes**

[RFC5576] defines a mechanism to describe RTP media sources, which
are identified by their synchronization source (SSRC) identifiers, in
SDP, to associate attributes with these sources, and to express
relationships among sources. It also defines several source-level
attributes that can be used to describe properties of media sources.

```
+----------------+---------------------+-------+------------------+
| Name           | Notes               | Level | Mux Category     |
+----------------+---------------------+-------+------------------+
| ssrc           | Refer to Notes below| M     | NORMAL           |
|                |                     |       |                  |
| ssrc-group     | Refer to Section 9  | M     | NORMAL           |
|                | for specific        |       |                  |
|                | analysis of the     |       |                  |
|                | grouping semantics  |       |                  |
|                |                     |       |                  |
| cname          | Not Impacted        | SR    | NORMAL           |
|                |                     |       |                  |
| previous-ssrc  | Refer to notes below| SR    | NORMAL           |
|                |                     |       |                  |
| fmtp           | The attribute value | SR    | IDENTICAL-PER-PT |
|                | MUST be same for a  |       |                  |
|                | given codec         |       |                  |
|                | configuration       |       |                  |
|                |                     |       |                  |
+----------------+---------------------+-------+------------------+
```

5.15 RFC5576 Attribute Analysis

NOTE: If SSRCs are repeated across "m=" lines being multiplexed, they
MUST all represent the same underlying RTP Source.

5.16. RFC7273: RTP Clock Source Signalling

[RFC7273] specifies SDP signalling that identifies timestamp
reference clock sources and SDP signalling that identifies the media
clock sources in a multimedia session.

```
+--------------------+---------------+-------+--------------+
| Name               | Notes         | Level | Mux Category |
+--------------------+---------------+-------+--------------+
| ts-refclk          | Not Impacted  | B     | NORMAL       |
|                    |               |       |              |
| mediaclk           | Not Impacted  | B     | NORMAL       |
|                    |               |       |              |
| ts-refclk:ntp      | Not Impacted  | B     | NORMAL       |
|                    |               |       |              |
| ts-refclk:ptp      | Not Impacted  | B     | NORMAL       |
|                    |               |       |              |
| ts-refclk:gps      | Not Impacted  | B     | NORMAL       |
|                    |               |       |              |
| ts-refclk:gal      | Not Impacted  | B     | NORMAL       |
|                    |               |       |              |
| ts-refclk:glonass  | Not Impacted  | B     | NORMAL       |
|                    |               |       |              |
| ts-refclk:local    | Not Impacted  | B     | NORMAL       |
|                    |               |       |              |
| ts-refclk:private  | Not Impacted  | B     | NORMAL       |
|                    |               |       |              |
| mediaclk:sender    | Not Impacted  | B     | NORMAL       |
|                    |               |       |              |
| mediaclk:direct    | Not Impacted  | B     | NORMAL       |
|                    |               |       |              |
| mediaclk:IEEE1722  | Not Impacted  | B     | NORMAL       |
|                    |               |       |              |
+--------------------+---------------+-------+--------------+
```

5.16 RFC7273 Attribute Analysis

5.17. RFC6236: Image Attributes in SDP

[RFC6236] proposes a new generic session setup attribute to make it
possible to negotiate different image attributes such as image size.
A possible use case is to make it possible for a low-end hand-held
terminal to display video without the need to rescale the image,
something that may consume large amounts of memory and processing
power. The document also helps to maintain an optimal bitrate for
video as only the image size that is desired by the receiver is
transmitted.

```
+-----------+--------------------------+-------+------------------+
| Name      | Notes                    | Level | Mux Category     |
+-----------+--------------------------+-------+------------------+
| imageattr | The attribute value MUST | M     | IDENTICAL-PER-PT |
|           | be same for a given      |       |                  |
|           | codec configuration      |       |                  |
|           |                          |       |                  |
+-----------+--------------------------+-------+------------------+
```

                 5.17 RFC6236 Attribute Analysis

5.18. RFC7197: Duplication Delay Attribute in SDP

   [RFC7197] defines an attribute to indicate the presence of temporally
   redundant media streams and the duplication delay in SDP.

```
+-------------------+---------------+-------+--------------+
| Name              | Notes         | Level | Mux Category |
+-------------------+---------------+-------+--------------+
| duplication-delay | Not Impacted  | B     | NORMAL       |
|                   |               |       |              |
+-------------------+---------------+-------+--------------+
```

                 5.18 RFC7197 Attribute Analysis

5.19. RFC7266: RTCP XR Blocks for MOS Metric Reporting

   [RFC7266] defines an RTCP Extended Report (XR) Block including two
   new segment types and associated SDP parameters that allow the
   reporting of mean opinion score (MOS) Metrics for use in a range of
   RTP applications.

```
+-------------+---------------+-------+--------------+
| Name        | Notes         | Level | Mux Category |
+-------------+---------------+-------+--------------+
| calgextmap  | Not Impacted  | B     | NORMAL       |
|             |               |       |              |
+-------------+---------------+-------+--------------+
```

                 5.19 RFC7266 Attribute Analysis

5.20. RFC6285: Rapid Acquisition of Multicast RTP Sessions

   [RFC6285] describes a method using the existing RTP and RTCP
   machinery that reduces the acquisition delay. In this method, an
   auxiliary unicast RTP session carrying the Reference Information to
   the receiver precedes or accompanies the multicast stream. This
   unicast RTP flow can be transmitted at a faster than natural bitrate

to further accelerate the acquisition. The motivating use case for
this capability is multicast applications that carry real-time
compressed audio and video.

```
+---------------+------------------+-------+--------------+
| Name          | Notes            | Level | Mux Category |
+---------------+------------------+-------+--------------+
| rams-updates  | Not recommended  | M     | CAUTION      |
|               |                  |       |              |
+---------------+------------------+-------+--------------+
```

5.20 RFC6285 Attribute Analysis

5.21. RFC6230: Media Control Channel Framework

[RFC6230] describes a framework and protocol for application
deployment where the application programming logic and media
processing are distributed. This implies that application
programming logic can seamlessly gain access to appropriate resources
that are not co-located on the same physical network entity. The
framework uses SIP to establish an application-level control
mechanism between application servers and associated external servers
such as media servers.

```
+---------+---------------+-------+--------------+
| Name    | Notes         | Level | Mux Category |
+---------+---------------+-------+--------------+
| cfw-id  | Not Impacted  | M     | NORMAL       |
|         |               |       |              |
+---------+---------------+-------+--------------+
```

5.21 RFC6230 Attribute Analysis

5.22. RFC6364: SDP Elements for FEC Framework

[RFC6364] specifies the use of SDP to describe the parameters
required to signal the Forward Error Correction (FEC) Framework
Configuration Information between the sender(s) and receiver(s).
This document also provides examples that show the semantics for
grouping multiple source and repair flows together for the
applications that simultaneously use multiple instances of the FEC
Framework.

Name	Notes	Level	Mux Category
fec-source-flow	Refer to the document defining specific FEC Scheme	M	SPECIAL
fec-repair-flow	Refer to the document defining specific FEC Scheme	M	SPECIAL
repair-window	Refer to the document defining specific FEC Scheme	M	SPECIAL

5.22 RFC6364 Attribute Analysis

5.23. RFC4796: Content Attribute

[RFC4796] defines a new SDP media-level attribute, 'content'. The
'content' attribute defines the content of the media stream to a more
detailed level than the media description line. The sender of an SDP
session description can attach the 'content' attribute to one or more
media streams. The receiving application can then treat each media
stream differently (e.g., show it on a big or small screen) based on
its content.

Name	Notes	Level	Mux Category
content	Not Impacted	M	NORMAL

5.23 RFC4796 Attribute Analysis

5.24. RFC3407: SDP Simple Capability Declaration

[RFC3407] defines a set of SDP attributes that enables SDP to provide
a minimal and backwards compatible capability declaration mechanism.

```
+----------+-----------------------+-------+-------------+
| Name     | Notes                 | Level | Mux Category |
+----------+-----------------------+-------+-------------+
| sqn      | Not Impacted          | B     | NORMAL      |
|          |                       |       |             |
| cdsc     | Not Impacted.         | B     | NORMAL      |
|          |                       |       |             |
| cpar     | Refer to Section 14   | B     | INHERIT     |
|          |                       |       |             |
| cparmin  | Refer to notes below  | B     | SPECIAL     |
|          |                       |       |             |
| cparmax  | Refer to notes below  | B     | SPECIAL     |
|          |                       |       |             |
+----------+-----------------------+-------+-------------+
```

                  5.24 RFC3407 Attribute Analysis

   NOTE: The attributes (a=cparmin and a=cparmax) define minimum and
   maximum numerical values associated with the attributes described in
   a=cpar.

   Since the cpar attribute can either define a 'b=' attribute or any
   'a=' attribute, the multiplexing category depends on actual attribute
   being encapsulated and the implications of the numerical values
   assigned. Hence it is recommended to consult the specification
   defining attributes (cparmin/cparmax) to further analyze their
   behavior under multiplexing.

5.25. RFC6284: Port Mapping between Unicast and Multicast RTP Sessions

   [RFC6284] presents a port mapping solution that allows RTP receivers
   to choose their own ports for an auxiliary unicast session in RTP
   applications using both unicast and multicast services. The solution
   provides protection against denial-of-service or packet amplification
   attacks that could be used to cause one or more RTP packets to be
   sent to a victim client.

```
+-----------------+---------------------------+-------+----------+
| Name            | Notes                     | Level | Mux      |
|                 |                           |       | Category |
+-----------------+---------------------------+-------+----------+
| portmapping-req | Not recommended, if port  | M     | CAUTION  |
|                 | mapping is required by the |      |          |
|                 | application               |       |          |
|                 |                           |       |          |
+-----------------+---------------------------+-------+----------+
```

                  5.25 RFC6284 Attribute Analysis

5.26. RFC6714: MSRP-CEMA

[RFC6714] defines a Message Session Relay Protocol (MSRP) extension,
Connection Establishment for Media Anchoring (CEMA). Support of this
extension is optional. The extension allows middle boxes to anchor
the MSRP connection, without the need for middle boxes to modify the
MSRP messages; thus, it also enables secure end-to-end MSRP
communication in networks where such middle boxes are deployed. This
document also defines a SDP attribute, 'msrp-cema', that MSRP
endpoints use to indicate support of the CEMA extension.

```
+------------+----------------------+-------+--------------+
| Name       | Notes                | Level | Mux Category |
+------------+----------------------+-------+--------------+
| msrp-cema  | Refer to notes below | M     | TBD          |
|            |                      |       |              |
+------------+----------------------+-------+--------------+
```

5.26 RFC6714 Attribute Analysis

NOTE: As per section 9.1 of [I-D.ietf-mmusic-sdp-bundle-negotiation],
there exists no publicly available specification that defines
procedures for multiplexing/demultiplexing MRSP flows over a single
5-tuple. Once such a specification is available, the multiplexing
categories assignments for the attributes in this section could be
revisited.

5.27. RFC4583: SDP Format for BFCP Streams

[RFC4583] document specifies how to describe Binary Floor Control
Protocol (BFCP) streams in SDP descriptions. User agents using the
offer/answer model to establish BFCP streams use this format in their
offers and answers.

```
+------------+-------------------------------+-------+------------+
| Name       | Notes                         | Level | Mux        |
|            |                               |       | Category   |
+------------+-------------------------------+-------+------------+
| floorctrl  | The attribute MUST be repeated | M    | IDENTICAL  |
|            | across all the multiplexed "m=" |     |            |
|            | lines                         |       |            |
|            |                               |       |            |
| confid     | Not Impacted                  | M     | NORMAL     |
|            |                               |       |            |
| userid     | Not Impacted                  | M     | NORMAL     |
|            |                               |       |            |
| floorid    | Not Impacted                  | M     | NORMAL     |
|            |                               |       |            |
+------------+-------------------------------+-------+------------+
```

5.27 RFC4583 Attribute Analysis

5.28. RFC5547: SDP Offer/Answer for File Transfer

[RFC5547] provides a mechanism to negotiate the transfer of one or
more files between two endpoints by using the SDP offer/answer model
specified in [RFC3264].

```
+-------------------+----------------------+-------+--------------+
| Name              | Notes                | Level | Mux Category |
+-------------------+----------------------+-------+--------------+
| file-selector     | Refer to notes below | M     | TBD          |
|                   |                      |       |              |
| file-transfer-id  | Refer to notes below | M     | TBD          |
|                   |                      |       |              |
| file-disposition  | Refer to notes below | M     | TBD          |
|                   |                      |       |              |
| file-date         | Refer to notes below | M     | TBD          |
|                   |                      |       |              |
| file-icon         | Refer to notes below | M     | TBD          |
|                   |                      |       |              |
| file-range        | Refer to notes below | M     | TBD          |
|                   |                      |       |              |
+-------------------+----------------------+-------+--------------+
```

5.28 RFC5547 Attribute Analysis

NOTE: As per section 9.1 of [I-D.ietf-mmusic-sdp-bundle-negotiation],
there exists no publicly available specification that defines
procedures for multiplexing/demultiplexing MRSP flows over a single
5-tuple. Once such a specification is available, the multiplexing

categories assignments for attributes in this section could be
revisited.

5.29. RFC6849: SDP and RTP Media Loopback Extension

[RFC6849] adds new SDP media types and attributes, which enable
establishment of media sessions where the media is looped back to the
transmitter. Such media sessions will serve as monitoring and
troubleshooting tools by providing the means for measurement of more
advanced Voice over IP (VoIP), Real-time Text, and Video over IP
performance metrics.

Name	Notes	Level	Mux Category
loopback rtp-pkt-loopback	The attribute value MUST be same for a given codec configuration	M	IDENTICAL-PER-PT
loopback rtp-media-loopback	The attribute value MUST be same for a given codec configuration	M	IDENTICAL-PER-PT
loopback-source	Not Impacted	M	NORMAL
loopback-mirror	Not Impacted	M	NORMAL

5.29 RFC6849 Analysis

5.30. RFC5760: RTCP with Unicast Feedback

[RFC5760] specifies an extension to RTCP to use unicast feedback to a
multicast sender. The proposed extension is useful for single-source
multicast sessions such as Source-Specific Multicast (SSM)
communication where the traditional model of many-to-many group
communication is either not available or not desired.

```
+---------------+-----------------------------+-------+------------+
| Name          | Notes                       | Level | Mux        |
|               |                             |       | Category   |
+---------------+-----------------------------+-------+------------+
| rtcp-unicast  | The attribute MUST be       | M     | IDENTICAL  |
|               | reported across all "m="    |       |            |
|               | lines multiplexed           |       |            |
|               |                             |       |            |
+---------------+-----------------------------+-------+------------+
```

                 5.30 RFC5760 Attribute Analysis

5.31. RFC3611: RTCP XR

   [RFC3611] defines the Extended Report (XR) packet type for RTCP, and
   defines how the use of XR packets can be signaled by an application
   if it employs the Session Description Protocol (SDP).

```
         +----------+---------------+-------+--------------+
         | Name     | Notes         | Level | Mux Category |
         +----------+---------------+-------+--------------+
         | rtcp-xr  | Not Impacted  | B     | NORMAL       |
         |          |               |       |              |
         +----------+---------------+-------+--------------+
```

                 5.31 RFC3611 Attribute Analysis

5.32. RFC5939: SDP Capability Negotiation

   [RFC5939] defines a general SDP Capability Negotiation framework. It
   also specifies how to provide attributes and transport protocols as
   capabilities and negotiate them using the framework. Extensions for
   other types of capabilities (e.g., media types and media formats) may
   be provided in other documents.

```
+---------+----------------------+-------+--------------+
| Name    | Notes                | Level | Mux Category |
+---------+----------------------+-------+--------------+
| pcfg    | Refer to Section 14  | M     | SPECIAL      |
|         |                      |       |              |
| acfg    | Refer to Section 14  | M     | SPECIAL      |
|         |                      |       |              |
| csup    | Not Impacted         | B     | NORMAL       |
|         |                      |       |              |
| creq    | Not Impacted         | B     | NORMAL       |
|         |                      |       |              |
| acap    | Refer to Section 14  | B     | INHERIT      |
|         |                      |       |              |
| tcap    | Refer to Section 14  | B     | INHERIT      |
|         |                      |       |              |
| cap-v0  | Not Impacted         | B     | NORMAL       |
|         |                      |       |              |
+---------+----------------------+-------+--------------+
```

                     5.32 RFC5939 Attribute Analysis

5.33. RFC6871: SDP Media Capabilities Negotiation

   SDP capability negotiation provides a general framework for
   indicating and negotiating capabilities in SDP. The base framework
   defines only capabilities for negotiating transport protocols and
   attributes. [RFC6871] extends the framework by defining media
   capabilities that can be used to negotiate media types and their
   associated parameters.

```
+---------+----------------------+-------+------------------+
| Name    | Notes                | Level | Mux Category     |
+---------+----------------------+-------+------------------+
| rmcap   | Refer to Section 14  | B     | IDENTICAL-PER-PT |
|         |                      |       |                  |
| omcap   | Not Impacted         | B     | NORMAL           |
|         |                      |       |                  |
| mfcap   | Refer to Section 14  | B     | IDENTICAL-PER-PT |
|         |                      |       |                  |
| mscap   | Refer to Section 14  | B     | INHERIT          |
|         |                      |       |                  |
| lcfg    | Refer to Section 14  | B     | SPECIAL          |
|         |                      |       |                  |
| sescap  | Refer to notes below | S     | CAUTION          |
|         |                      |       |                  |
| med-v0  | Not Impacted         | S     | NORMAL           |
|         |                      |       |                  |
+---------+----------------------+-------+------------------+
```

5.33 RFC6871 - Attribute Analysis

NOTE: The "sescap" attribute is not recommended for use with
multiplexing. The reason is that it requires the use of unique
configuration numbers across the entire SDP (per [RFC6871]) as
opposed to within a media description only (per [RFC5939]). As
described in Section 14, the use of identical configuration numbers
between multiplexed (bundled) media descriptions is the default way
of indicating compatible configurations in a bundle.

5.34. RFC7006: Miscellaneous Capabilities Negotiation SDP

[RFC7006] extends the SDP capability negotiation framework to allow
endpoints to negotiate three additional SDP capabilities. In
particular, this memo provides a mechanism to negotiate bandwidth
("b=" line), connection data ("c=" line), and session or media titles
("i=" line for each session or media).

Name	Notes	Level	Mux Category
bcap	Inherit the category SUM as applicable to b= attribute	B	INHERIT
bcap-v0	Not Impacted	B	NORMAL
ccap	The connection address type MUST be identical across all the multiplexed "m=" lines	B	IDENTICAL
ccap-v0	Not Impacted	B	NORMAL
icap	Not Impacted	B	NORMAL
icap-v0	Not Impacted	B	NORMAL

                5.34 RFC7006 - Attribute Analysis

5.35. RFC4567: Key Management Extensions for SDP and RTSP

[RFC4567] defines general extensions for SDP and Real Time Streaming
Protocol (RTSP) to carry messages, as specified by a key management
protocol, in order to secure the media. These extensions are
presented as a framework, to be used by one or more key management
protocols. As such, their use is meaningful only when complemented
by an appropriate key management protocol.

Name	Notes	Level	Mux Category
key-mgmt	Key management protocol MUST be identical across all the "m=" lines	B	IDENTICAL
mikey	Key management protocol MUST be identical across all the "m=" lines	B	IDENTICAL

                5.35 RFC4567 Attribute Analysis

5.36. RFC4572: Comedia over TLS in SDP

[RFC4572] specifies how to establish secure connection-oriented media
transport sessions over the Transport Layer Security (TLS) protocol
using SDP. It defines a new SDP protocol identifier, 'TCP/TLS'. It
also defines the syntax and semantics for an SDP 'fingerprint'
attribute that identifies the certificate that will be presented for
the TLS session. This mechanism allows media transport over TLS
connections to be established securely, so long as the integrity of
session descriptions is assured.

| Name | Notes | Level | Mux |
			Category
fingerprint	fingerprint value from the	B	TRANSPORT
	"m=" line defining the		
	underlying transport is		
	chosen		

5.36 RFC4572 Attribute Analysis

5.37. RFC4570: SDP Source Filters

[RFC4570] describes how to adapt SDP to express one or more source
addresses as a source filter for one or more destination "connection"
addresses. It defines the syntax and semantics for an SDP "source-
filter" attribute that may reference either IPv4 or IPv6 address(es)
as either an inclusive or exclusive source list for either multicast
or unicast destinations. In particular, an inclusive source-filter
can be used to specify a Source-Specific Multicast (SSM) session.

| Name | Notes | Level | Mux |
			Category
source-filter	The attribute MUST be	B	IDENTICAL
	repeated across all "m="		
	lines multiplexed		

5.37 RFC4570 Attribute Analysis

5.38. RFC6128: RTCP Port for Multicast Sessions

   SDP has an attribute that allows RTP applications to specify an
   address and a port associated with the RTCP traffic. In RTP-based
   source-specific multicast (SSM) sessions, the same attribute is used
   to designate the address and the RTCP port of the Feedback Target in
   the SDP description. However, the RTCP port associated with the SSM
   session itself cannot be specified by the same attribute to avoid
   ambiguity, and thus, is required to be derived from the "m=" line of
   the media description. Deriving the RTCP port from the "m=" line
   imposes an unnecessary restriction. [RFC6128] removes this
   restriction by introducing a new SDP attribute.

Name	Notes	Level	Mux Category
multicast-rtcp	Multicast RTCP port MUST be identical across all the "m=" lines	B	IDENTICAL

                     5.38 RFC6128 Attribute Analysis

5.39. RFC6189: ZRTP

   [RFC6189] defines ZRTP, a protocol for media path Diffie-Hellman
   exchange to agree on a session key and parameters for establishing
   unicast SRTP sessions for (VoIP applications.

Name	Notes	Level	Mux Category
zrtp-hash	zrtp-hash attribute MUST be the one that corresponds to the "m=" line chosen for setting up the underlying transport flow	M	TRANSPORT

                     5.39 RFC6189 Attribute Analysis

5.40. RFC4145: Connection-Oriented Media

[RFC4145] describes how to express media transport over TCP using
SDP. It defines the SDP 'TCP' protocol identifier, the SDP 'setup'
attribute, which describes the connection setup procedure, and the
SDP 'connection' attribute, which handles connection reestablishment.

```
+-------------+-----------------------------+-------+-----------+
| Name        | Notes                       | Level | Mux       |
|             |                             |       | Category  |
+-------------+-----------------------------+-------+-----------+
| setup       | The setup attribute MUST be | B     | TRANSPORT |
|             | the one that corresponds to |       |           |
|             | the "m=" line chosen for    |       |           |
|             | setting up the underlying   |       |           |
|             | transport flow.             |       |           |
|             |                             |       |           |
| connection  | The connection attribute MUST| B    | TRANSPORT |
|             | be the one that corresponds to|     |           |
|             | the "m=" line chosen for    |       |           |
|             | setting up the underlying   |       |           |
|             | transport flow.             |       |           |
|             |                             |       |           |
+-------------+-----------------------------+-------+-----------+
```

                5.40 RFC4145 Attribute Analysis

5.41. RFC6947: The SDP altc Attribute

[RFC6947] proposes a mechanism that allows the same SDP offer to
carry multiple IP addresses of different address families (e.g., IPv4
and IPv6). The proposed attribute, the "altc" attribute, solves the
backward-compatibility problem that plagued Alternative Network
Address Types (ANAT) due to their syntax.

```
+-------+-------------------------------------+-------+-----------+
| Name  | Notes                               | Level | Mux       |
|       |                                     |       | Category  |
+-------+-------------------------------------+-------+-----------+
| altc  | The IP Address and port MUST be the | M     | TRANSPORT |
|       | one that corresponds to the "m="    |       |           |
|       | line chosen for setting up the      |       |           |
|       | underlying transport flow           |       |           |
|       |                                     |       |           |
+-------+-------------------------------------+-------+-----------+
```

                5.41 RFC6947 Attribute Analysis

5.42. **RFC7195: SDP Extension for Circuit Switched Bearers in PSTN**

   [RFC7195] describes use cases, requirements, and protocol extensions
   for using SDP offer/answer model for establishing audio and video
   media streams over circuit-switched bearers in the Public Switched
   Telephone Network (PSTN).

   | Name | Notes | Level | Mux |
			Category
cs-correlation:callerid	Refer to notes	M	TBD
	below		
cs-correlation:uuie	Refer to notes	M	TBD
	below		
cs-correlation:dtmf	Refer to notes	M	TBD
	below		
cs-correlation:external	Refer to notes	M	TBD
	below		

                     5.42 RFC7195 Attribute Analysis

   NOTE: [RFC7195] defines SDP attributes for establishing audio and
   video media streams over circuit-switched bearers by defining a new
   nettype value "PSTN". However, section 7.2 of
   [I-D.ietf-mmusic-sdp-bundle-negotiation] requires the "c=" line
   nettype value of "IN". If in future there exists a specification
   that defines procedures to multiplex media streams over nettype
   "PSTN", the multiplexing categories for attributes in this section
   could be revisited.

5.43. **RFC7272: IDMS Using the RTP Control Protocol (RTCP)**

   [RFC7272] defines a new RTCP Packet Type and an RTCP Extended Report
   (XR) Block Type to be used for achieving Inter-Destination Media
   Synchronization (IDMS).

```
+------------+--------------+-------+-------------+
| Name       | Notes        | Level | Mux Category |
+------------+--------------+-------+-------------+
| rtcp-idms  | Not Impacted | M     | NORMAL      |
|            |              |       |             |
+------------+--------------+-------+-------------+
```

5.43 RFC7272 Attribute Analysis

5.44. RFC5159: Open Mobile Alliance (OMA) Broadcast (BCAST) SDP Attributes

[RFC5159] provides descriptions of SDP attributes used by the Open
Mobile Alliance's Broadcast Service and Content Protection
specification.

```
+---------------------+----------------------+-------+-------------+
| Name                | Notes                | Level | Mux         |
|                     |                      |       | Category    |
+---------------------+----------------------+-------+-------------+
| bcastversion        | Not Impacted         | S     | NORMAL      |
|                     |                      |       |             |
| stkmstream          | Not Impacted         | B     | NORMAL      |
|                     |                      |       |             |
| SRTPAuthentication  | Needs further        | M     | TBD         |
|                     | analysis             |       |             |
|                     |                      |       |             |
| SRTPROCTxRate       | Needs further        | M     | TBD         |
|                     | analysis             |       |             |
|                     |                      |       |             |
+---------------------+----------------------+-------+-------------+
```

5.44 RFC5159 Attribute Analysis

5.45. RFC6193: Media Description for IKE in SDP

[RFC6193] specifies how to establish a media session that represents
a virtual private network using the Session Initiation Protocol for
the purpose of on-demand media/application sharing between peers. It
extends the protocol identifier of SDP so that it can negotiate use
of the Internet Key Exchange Protocol (IKE) for media sessions in the
SDP offer/answer model.

```
+------------------+---------------------------+-------+----------+
| Name             | Notes                     | Level | Mux      |
|                  |                           |       | Category |
+------------------+---------------------------+-------+----------+
| ike-setup        | Unlikely to use IKE in the| B     | CAUTION  |
|                  | context of multiplexing   |       |          |
|                  |                           |       |          |
| psk-fingerprint  | Unlikely to use IKE in the| B     | CAUTION  |
|                  | context of multiplexing   |       |          |
|                  |                           |       |          |
| ike-esp          | Unlikely to use IKE in the| B     | CAUTION  |
|                  | context of multiplexing   |       |          |
|                  |                           |       |          |
| ike-esp-udpencap | Unlikely to use IKE in the| B     | CAUTION  |
|                  | context of multiplexing   |       |          |
|                  |                           |       |          |
+------------------+---------------------------+-------+----------+
```

                   5.45 RFC6193 Attribute Analysis

5.46. RFC2326: Real Time Streaming Protocol

   The Real Time Streaming Protocol, or RTSP, is an application-level
   protocol for control over the delivery of data with real-time
   properties. RTSP provides an extensible framework to enable
   controlled, on-demand delivery of real-time data, such as audio and
   video.

```
+----------+-----------------------------+-------+----------+
| Name     | Notes                       | Level | Mux      |
|          |                             |       | Category |
+----------+-----------------------------+-------+----------+
| etag     | RTSP is not supported for RTP| B    | CAUTION  |
|          | Stream multiplexing         |       |          |
|          |                             |       |          |
| range    | RTSP is not supported for RTP| B    | CAUTION  |
|          | Stream multiplexing         |       |          |
|          |                             |       |          |
| control  | RTSP is not supported for RTP| B    | CAUTION  |
|          | Stream multiplexing         |       |          |
|          |                             |       |          |
| mtag     | RTSP is not supported for RTP| B    | CAUTION  |
|          | Stream multiplexing         |       |          |
|          |                             |       |          |
+----------+-----------------------------+-------+----------+
```

                   5.46 RFC2326 Attribute Analysis

NOTE: [RFC2326] defines SDP attributes that are applicable in the
declarative usage of SDP alone. For purposes of this document, only
the Offer/Answer usage of SDP is considered as mandated by
[I-D.ietf-mmusic-sdp-bundle-negotiation].

5.47. RFC6064: SDP and RTSP Extensions for 3GPP

The Packet-switched Streaming Service (PSS) and the Multimedia
Broadcast/Multicast Service (MBMS) defined by 3GPP use SDP and RTSP
with some extensions. [RFC6064] provides information about these
extensions and registers the RTSP and SDP extensions with IANA.

Name	Notes	Level	Mux Category
X-predecbufsize	Refer to notes below	M	CAUTION
X-initpredecbufperiod	Refer to notes below	M	CAUTION
X-initpostdecbufperiod	Refer to notes below	M	CAUTION
X-decbyterate	Refer to notes below	M	CAUTION
3gpp-videopostdecbufsize	Refer to notes below	M	CAUTION
framesize	Refer to notes below	M	CAUTION
3GPP-Integrity-Key	Refer to notes below	S	CAUTION
3GPP-SDP-Auth	Refer to notes below	S	CAUTION
3GPP-SRTP-Config	Refer to notes below	M	CAUTION
alt	Refer to notes below	M	CAUTION
alt-default-id	Refer to notes below	M	CAUTION

alt-group	Refer to notes below	S	CAUTION	
3GPP-Adaptation-Support	Refer to notes below	M	CAUTION	
3GPP-Asset-Information	Refer to notes below	B	CAUTION	
mbms-mode	Refer to notes below	B	CAUTION	
mbms-flowid	Refer to notes below	M	CAUTION	
mbms-repair	Refer to notes below	B	CAUTION	
3GPP-QoE-Metrics	Refer to notes below	M	CAUTION	
3GPP-QoE-Metrics:Corruption duration	Refer to notes below	M	CAUTION	
3GPP-QoE-Metrics:Rebuffering duration	Refer to notes below	M	CAUTION	
3GPP-QoE-Metrics:Initial buffering duration	Refer to notes below	M	CAUTION	
3GPP-QoE-Metrics:Successive loss of RTP packets	Refer to notes below	M	CAUTION	
3GPP-QoE-Metrics:Frame rate deviation	Refer to notes below	M	CAUTION	
3GPP-QoE-Metrics:Jitter duration	Refer to notes below	M	CAUTION	
3GPP-QoE-Metrics:Content Switch Time	Refer to notes below	B	CAUTION	
3GPP-QoE-Metrics:Average Codec Bitrate	Refer to notes below	M	CAUTION	
3GPP-QoE-Metrics:Codec Information	Refer to notes below	M	CAUTION	

```
|                                |               |       |          |
| 3GPP-QoE-Metrics:Buffer Status | Refer to      | M     | CAUTION  |
|                                | notes below   |       |          |
|                                |               |       |          |
+--------------------------------+---------------+-------+----------+
```

                5.47 RFC6064 Attribute Analysis

   NOTE: [RFC6064] defines SDP attributes that are applicable in the
   declarative usage of SDP alone. For purposes of this document, only
   the Offer/Answer usage of SDP is considered as mandated by
   [I-D.ietf-mmusic-sdp-bundle-negotiation].

5.48. RFC3108: ATM SDP

   [RFC3108] describes conventions for using SDP described for
   controlling ATM Bearer Connections, and any associated ATM Adaptation
   Layer (AAL).

Name	Notes	Level	Mux Category
aalType	Refer to notes below	B	CAUTION
eecid	Refer to notes below	B	CAUTION
capability	Refer to notes below	B	CAUTION
qosClass	Refer to notes below	B	CAUTION
bcob	Refer to notes below	B	CAUTION
stc	Refer to notes below	B	CAUTION
upcc	Refer to notes below	B	CAUTION
atmQOSparms	Refer to notes below	B	CAUTION
atmTrfcDesc	Refer to notes below	B	CAUTION
abrParms	Refer to notes below	B	CAUTION
abrSetup	Refer to notes below	B	CAUTION
bearerType	Refer to notes below	B	CAUTION
lij	Refer to notes below	B	CAUTION

	below			
anycast	Refer to notes	B	CAUTION
	below			
cache	Refer to notes	B	CAUTION
	below			
bearerSigIE	Refer to notes	B	CAUTION
	below			
aalApp	Refer to notes	B	CAUTION
	below			
cbrRate	Refer to notes	B	CAUTION
	below			
sbc	Refer to notes	B	CAUTION
	below			
clkrec	Refer to notes	B	CAUTION
	below			
fec	Refer to notes	B	CAUTION
	below			
prtfl	Refer to notes	B	CAUTION
	below			
structure	Refer to notes	B	CAUTION
	below			
cpsSDUsize	Refer to notes	B	CAUTION
	below			
aal2CPS	Refer to notes	B	CAUTION
	below			
aal2CPSSDUrate	Refer to notes	B	CAUTION
	below			
aal2sscs3661unassured	Refer to notes	B	CAUTION
	below			
aal2sscs3661assured	Refer to notes	B	CAUTION
	below			
aal2sscs3662	Refer to notes	B	CAUTION
	below			
aal5sscop	Refer to notes	B	CAUTION
	below			
atmmap	Refer to notes	B	CAUTION
	below			
silenceSupp	Refer to notes	B	CAUTION
	below			
ecan	Refer to notes	B	CAUTION
	below			
gc	Refer to notes	B	CAUTION
	below			
profileDesc	Refer to notes	B	CAUTION
	below			
vsel	Refer to notes	B	CAUTION
	below			
dsel	Refer to notes	B	CAUTION

	below			
fsel	Refer to notes below	B	CAUTION	
onewaySel	Refer to notes below	B	CAUTION	
codecconfig	Refer to notes below	B	CAUTION	
isup_usi	Refer to notes below	B	CAUTION	
uiLayer1_Prot	Refer to notes below	B	CAUTION	
chain	Refer to notes below	B	CAUTION	

5.48 RFC3108 Attribute Analysis

NOTE: RFC3108 describes conventions for using SDP for characterizing
ATM bearer connections using an AAL1, AAL2 or AAL5 adaptation layers.
For AAL1, AAL2 and AAL5, bearer connections can be used to transport
single media streams. In addition, for AAL1 and AAL2, multiple media
streams can be multiplexed into a bearer connection. For all
adaptation types (AAL1, AAL2 and AAL5), bearer connections can be
bundled into a single media group. In all cases addressed by
RFC3108, a real-time media stream (voice, video, voiceband data,
pseudo-wire, and others) or a multiplex of media streams is mapped
directly into an ATM connection. RFC3108 does not address cases
where ATM serves as a low-level transport pipe for IP packets which
in turn can carry one or more real-time (e.g. VoIP) media sessions
with a life-cycle different from that of the underlying ATM
transport.

5.49. 3GPP TS 26.114

[R3GPPTS26.114] specifies IP multimedia subsystem: Media handling and
interaction

Name	Notes	Level	Mux Category
3gpp_sync_info	Usage defined for the IP Multimedia Subsystem	M	NORMAL
3gpp_MaxRecvSDUSize	Usage defined for the IP Multimedia Subsystem	M	NORMAL

5.49 3GPP TS 26.114 Attribute Analysis

5.50. 3GPP TS 183.063

[R3GPPTS183.063] Telecommunications and Internet converged Services
and Protocols for Advanced Networking (TISPAN);

Name	Notes	Level	Mux Category
PSCid	Not Impacted	S	NORMAL
bc_service	Not Impacted	S	NORMAL
bc_program	Not Impacted	S	NORMAL
bc_service_package	Not Impacted	S	NORMAL

5.50 3GPP TS 183.063 Attribute Analysis

5.51. 3GPP TS 24.182

[R3GPPTS24.182] specifies IP multimedia subsystem Custom Alerting
tones

```
+-------------+-------------------------------+-------+-----------+
| Name        | Notes                         | Level | Mux       |
|             |                               |       | Category  |
+-------------+-------------------------------+-------+-----------+
| g.3gpp.cat  | Usage defined for the IP      | M     | NORMAL    |
|             | Multimedia Subsystem          |       |           |
|             |                               |       |           |
+-------------+-------------------------------+-------+-----------+
```

              5.51 3GPP TS 24.182 Attribute Analysis

5.52. 3GPP TS 24.183

[R3GPPTS24.183] specifies IP multimedia subsystem Custom Ringing
Signal

```
+-------------+-------------------------------+-------+-----------+
| Name        | Notes                         | Level | Mux       |
|             |                               |       | Category  |
+-------------+-------------------------------+-------+-----------+
| g.3gpp.crs  | Usage defined for the IP      | M     | NORMAL    |
|             | Multimedia Subsystem          |       |           |
|             |                               |       |           |
+-------------+-------------------------------+-------+-----------+
```

              5.52 3GPP TS 24.183 Attribute Analysis

5.53. 3GPP TS 24.229

[R3GPPTS24.229] specifies IP multimedia call control protocol based
on Session Initial protocol and Session Description Protocol.

Name	Notes	Level	Mux Category
secondary-realm	secondary-realm MUST be the one that corresponds to the "m=" line chosen for setting up the underlying transport flow	M	TRANSPORT
visited-realm	visited-realm MUST be the one that corresponds to the "m=" line chosen for setting up the underlying transport flow	M	TRANSPORT
omr-m-cksum	Not Impacted	M	NORMAL
omr-s-cksum	Not Impacted	M	NORMAL
omr-m-att	Not Impacted	M	NORMAL
omr-s-att	Not Impacted	M	NORMAL
omr-m-bw	Not Impacted	M	NORMAL
omr-s-bw	Not Impacted	M	NORMAL
omr-codecs	Not Impacted	M	NORMAL

5.53 3GPP TS 24.229 Attribute Analysis

5.54. ITU T.38

[T.38] defines procedures for real-time Group 3 facsimile
communications over IP networks.

Name	Notes	Level	Mux Category
T38FaxVersion	Refer to notes below	M	TBD
T38MaxBitRate	Refer to notes below	M	TBD

T38FaxFillBitRemoval	Refer to notes below	M	TBD	
T38FaxTranscodingMMR	Refer to notes below	M	TBD	
T38FaxTranscodingJBIG	Refer to notes below	M	TBD	
T38FaxRateManagement	Refer to notes below	M	TBD	
T38FaxMaxBuffer	Refer to notes below	M	TBD	
T38FaxMaxDatagram	Refer to notes below	M	TBD	
T38FaxUdpEC	Refer to notes below	M	TBD	
T38FaxMaxIFP	Refer to notes below	M	TBD	
T38FaxUdpECDepth	Refer to notes below	M	TBD	
T38FaxUdpFECMaxSpan	Refer to notes below	M	TBD	
T38ModemType	Refer to notes below	M	TBD	
T38VendorInfo	Refer to notes below	M	TBD	

5.54 ITU T.38 Attribute Analysis

NOTE: As per section 9.1 of [I-D.ietf-mmusic-sdp-bundle-negotiation], there exists no publicly available specification that defines procedures for multiplexing/demultiplexing fax protocols flows over a single 5-tuple. Once such a specification is available, the multiplexing category assignments for the attributes in this section could be revisited.

5.55. ITU-T Q.1970

[Q.1970] defines Bearer Independent Call Control (BICC) IP bearer
control protocol.

```
+--------+--------------------------------------+-------+----------+
| Name   | Notes                                | Level | Mux      |
|        |                                      |       | Category |
+--------+--------------------------------------+-------+----------+
| ipbcp  | ipbcp version identifies type of IP  | S     | SPECIAL  |
|        | bearer control protocol (IPBCP)      |       |          |
|        | message used in BICC (ITU-T Q.1901)  |       |          |
|        | environment which are limited to     |       |          |
|        | single media payload. Refer to the   |       |          |
|        | pertinent ITU-T specifications while  |       |          |
|        | multiplexing                         |       |          |
|        |                                      |       |          |
+--------+--------------------------------------+-------+----------+
```

                5.55 ITU-T Q.1970 Attribute Analysis

5.56. ITU-T H.248.15

ITU-T H.248.15 [H.248.15] defines Gateway Control Protocol SDP H.248
package attribute

Name	Notes	Level	Mux Category
h248item	It is only applicable for signaling the inclusion of H.248 extension packages to a gateway via the local and remote descriptors. The attribute itself is unaffected by multiplexing, but the packaged referenced in a specific use of the attribute can be impacted. Further analysis of each package is needed to determine if there is an issue. This is only a concern in environments using a decomposed server/gateway with H.248 signaled between them. The ITU-T will need to do further analysis of various packages when they specify how to signal the use of multiplexing to a gateway	B	SPECIAL

5.56 ITU-T H.248.15 Attribute Analysis

5.57. RFC4975: The Message Session Relay Protocol

[RFC4975] the Message Session Relay Protocol, a protocol for
transmitting a series of related instant messages in the context of a
session. Message sessions are treated like any other media stream
when set up via a rendezvous or session creation protocol such as the
Session Initiation Protocol.

```
+----------------------+--------------------+-------+------------+
| Name                 | Notes              | Level | Mux        |
|                      |                    |       | Category   |
+----------------------+--------------------+-------+------------+
| accept-types         | Refer to notes     | M     | TBD        |
|                      | below              |       |            |
|                      |                    |       |            |
| accept-wrapped-types | Refer to notes     | M     | TBD        |
|                      | below              |       |            |
|                      |                    |       |            |
| max-size             | Refer to notes     | M     | TBD        |
|                      | below              |       |            |
|                      |                    |       |            |
| path                 | Refer to notes     | M     | TBD        |
|                      | below              |       |            |
|                      |                    |       |            |
+----------------------+--------------------+-------+------------+
```

               5.57 RFC4975 Attribute Analysis

   NOTE: As per section 9.1 of [I-D.ietf-mmusic-sdp-bundle-negotiation],
   there exists no publicly available specification that defines
   procedures for multiplexing/demultiplexing MRSP flows over a single
   5-tuple. Once such a specification is available, the multiplexing
   categories assignments for the attributes in this section could be
   revisited.

5.58. Historical Attributes

   This section specifies analysis for the attributes that are included
   for historic usage alone by the [IANA].

```
        +----------+---------------------+-------+--------------+
        | Name     | Notes               | Level | Mux Category |
        +----------+---------------------+-------+--------------+
        | rtpred1  | Historic attributes | M     | CAUTION      |
        |          |                     |       |              |
        | rtpred2  | Historic attributes | M     | CAUTION      |
        |          |                     |       |              |
        +----------+---------------------+-------+--------------+
```

               5.58 Historical Attribute Analysis

6. bwtype Attribute Analysis

   This section specifies handling of specific bandwidth attributes when
   used in multiplexing scenarios.

6.1. RFC4566: SDP

[RFC4566] defines SDP that is intended for describing multimedia
sessions for the purposes of session announcement, session
invitation, and other forms of multimedia session initiation.

```
+------------+---------------------------------+-------+----------+
| Name       | Notes                           | Level | Mux      |
|            |                                 |       | Category |
+------------+---------------------------------+-------+----------+
| bwtype:CT  | Not Impacted                    | S     | NORMAL   |
|            |                                 |       |          |
| bwtype:AS  | For the media level usage, the  | B     | SUM      |
|            | aggregate of individual bandwidth |     |          |
|            | values is considered            |       |          |
|            |                                 |       |          |
+------------+---------------------------------+-------+----------+
```

6.1 RFC4566 bwtype Analysis

6.2. RFC3556: SDP Bandwidth Modifiers for RTCP Bandwidth

[RFC3556] defines an extension to SDP to specify two additional
modifiers for the bandwidth attribute. These modifiers may be used
to specify the bandwidth allowed for RTCP packets in a RTP session.

```
+------------+---------------------------------+-------+----------+
| Name       | Notes                           | Level | Mux      |
|            |                                 |       | Category |
+------------+---------------------------------+-------+----------+
| bwtype:RS  | Session level usage represents  | B     | SUM      |
|            | session aggregate and media level |     |          |
|            | usage indicates SUM of the      |       |          |
|            | individual values while         |       |          |
|            | multiplexing                    |       |          |
|            |                                 |       |          |
| bwtype:RR  | Session level usage represents  | B     | SUM      |
|            | session aggregate and media level |     |          |
|            | usage indicates SUM of the      |       |          |
|            | individual values while         |       |          |
|            | multiplexing                    |       |          |
|            |                                 |       |          |
+------------+---------------------------------+-------+----------+
```

6.2 RFC3556 bwtype Analysis

6.3. RFC3890: Bandwidth Modifier for SDP

[RFC3890] defines SDP Transport Independent Application Specific
Maximum (TIAS) bandwidth modifier that does not include transport
overhead; instead an additional packet rate attribute is defined.
The transport independent bit-rate value together with the maximum
packet rate can then be used to calculate the real bit-rate over the
transport actually used.

```
+--------------+-------------------------------+-------+----------+
| Name         | Notes                         | Level | Mux      |
|              |                               |       | Category |
+--------------+-------------------------------+-------+----------+
| bwtype:TIAS  | The usage of TIAS is not      | B     | SPECIAL  |
|              | defined under Offer/Answer    |       |          |
|              | usage.                        |       |          |
|              |                               |       |          |
| maxprate     | The usage of TIAS and maxprate| B     | SPECIAL  |
|              | is not well defined under     |       |          |
|              | multiplexing                  |       |          |
|              |                               |       |          |
+--------------+-------------------------------+-------+----------+
```

6.3 RFC3890 bwtype Analysis

NOTE: The intention of TIAS is that the media level bit-rate is
multiplied with the known per-packet overhead for the selected
transport and the maxprate value to determine the worst case bit-rate
from the transport to more accurately capture the required usage.
Summing TIAS values independently across "m=" lines and multiplying
the computed sum with maxprate and the per-packet overhead would
inflate the value significantly. Instead performing multiplication
and adding the individual values is a more appropriate usage.

7. rtcp-fb Attribute Analysis

This section analyzes rtcp-fb SDP attributes.

7.1. RFC4585: RTP/AVPF

[RFC4585] defines an extension to the Audio-visual Profile (AVP) that
enables receivers to provide, statistically, more immediate feedback
to the senders and thus allows for short-term adaptation and
efficient feedback-based repair mechanisms to be implemented.

```
+----------+---------------------------+-------+------------------+
| Name     | Notes                     | Level | Mux Category     |
+----------+---------------------------+-------+------------------+
| ack rpsi | The attribute value MUST  | M     | IDENTICAL-PER-PT |
|          | be same for a given codec |       |                  |
|          | configuration             |       |                  |
|          |                           |       |                  |
| ack app  | Feedback parameters MUST  | M     | SPECIAL          |
|          | be handled in the app     |       |                  |
|          | specific way when         |       |                  |
|          | multiplexed               |       |                  |
|          |                           |       |                  |
| nack     | The attribute value MUST  | M     | IDENTICAL-PER-PT |
|          | be same for a given codec |       |                  |
|          | configuration             |       |                  |
|          |                           |       |                  |
| nack pli | The attribute value MUST  | M     | IDENTICAL-PER-PT |
|          | be same for a given codec |       |                  |
|          | configuration             |       |                  |
|          |                           |       |                  |
| nack sli | The attribute value MUST  | M     | IDENTICAL-PER-PT |
|          | be same for a given codec |       |                  |
|          | configuration             |       |                  |
|          |                           |       |                  |
| nack     | The attribute value MUST  | M     | IDENTICAL-PER-PT |
| rpsi     | be same for a given codec |       |                  |
|          | configuration             |       |                  |
|          |                           |       |                  |
| nack app | Feedback parameters MUST  | M     | SPECIAL          |
|          | be handled in the app     |       |                  |
|          | specific way when         |       |                  |
|          | multiplexed               |       |                  |
|          |                           |       |                  |
| trr-int  | The attribute value MUST  | M     | IDENTICAL-PER-PT |
|          | be same for a given codec |       |                  |
|          | configuration             |       |                  |
|          |                           |       |                  |
+----------+---------------------------+-------+------------------+
```

7.1 RFC4585 Attribute Analysis

7.2. RFC5104: Codec Control Messages in AVPF

[RFC5104] specifies a few extensions to the messages defined in the
Audio-Visual Profile with Feedback (AVPF). They are helpful
primarily in conversational multimedia scenarios where centralized
multipoint functionalities are in use. However, some are also usable
in smaller multicast environments and point-to-point calls.

```
+------+-------------------------------+-------+------------------+
| Name | Notes                         | Level | Mux Category     |
+------+-------------------------------+-------+------------------+
| ccm  | The attribute value MUST be   | M     | IDENTICAL-PER-PT |
|      | same for a given codec        |       |                  |
|      | configuration                 |       |                  |
|      |                               |       |                  |
+------+-------------------------------+-------+------------------+
```

7.2 RFC5104 Attribute Analysis

7.3. RFC6285: Unicast-Based Rapid Acquisition of Multicast RTP Sessions (RAMS)

[RFC6285] describes a method using the existing RTP and RTCP
machinery that reduces the acquisition delay. In this method, an
auxiliary unicast RTP session carrying the Reference Information to
the receiver precedes or accompanies the multicast stream. This
unicast RTP flow can be transmitted at a faster than natural bitrate
to further accelerate the acquisition. The motivating use case for
this capability is multicast applications that carry real-time
compressed audio and video.

```
+-------+-------------------------------+-------+------------------+
| Name  | Notes                         | Level | Mux Category     |
+-------+-------------------------------+-------+------------------+
| nack  | The attribute value MUST be   | M     | IDENTICAL-PER-PT |
| rai   | same for a given codec        |       |                  |
|       | configuration                 |       |                  |
|       |                               |       |                  |
+-------+-------------------------------+-------+------------------+
```

7.3 RFC6285 Attribute Analysis

7.4. RFC6679: ECN for RTP over UDP/IP

[RFC6679] specifies how Explicit Congestion Notification (ECN) can be
used with the RTP running over UDP, using the RTCP as a feedback
mechanism. It defines a new RTCP Extended Report (XR) block for
periodic ECN feedback, a new RTCP transport feedback message for
timely reporting of congestion events, and a STUN extension used in
the optional initialization method using ICE.

```
+-----------------+-------------------------+-------+------------+
| Name            | Notes                   | Level | Mux        |
|                 |                         |       | Category   |
+-----------------+-------------------------+-------+------------+
| ecn-capable-rtp | ECN markup are enabled at | M    | IDENTICAL  |
|                 | the RTP session level   |       |            |
|                 |                         |       |            |
| nack ecn        | This attribute enables  | M     | IDENTICAL  |
|                 | ECN at the RTP session  |       |            |
|                 | level                   |       |            |
|                 |                         |       |            |
+-----------------+-------------------------+-------+------------+
```

                7.4 RFC6679 Attribute Analysis

7.5. RFC6642: Third-Party Loss Report

   In a large RTP session using the RTCP feedback mechanism defined in
   [RFC4585], 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. [RFC6642] memo discusses these cases and defines
   a new RTCP Third-Party Loss Report that can be used to inform
   receivers that the feedback target is aware of some loss event,
   allowing them to suppress feedback. Associated SDP signaling is also
   defined.

```
+--------+-----------------------------+-------+------------------+
| Name   | Notes                       | Level | Mux Category     |
+--------+-----------------------------+-------+------------------+
| nack   | The attribute value MUST be | M     | IDENTICAL-PER-PT |
| tllei  | same for a given codec      |       |                  |
|        | configuration               |       |                  |
|        |                             |       |                  |
| nack   | The attribute value MUST be | M     | IDENTICAL-PER-PT |
| pslei  | same for a given codec      |       |                  |
|        | configuration               |       |                  |
|        |                             |       |                  |
+--------+-----------------------------+-------+------------------+
```

                7.5 RFC6642 Attribute Analysis

7.6. RFC5104: Codec Control Messages in AVPF

[RFC5104] specifies a few extensions to the messages defined in the
Audio-Visual Profile with Feedback (AVPF). They are helpful
primarily in conversational multimedia scenarios where centralized
multipoint functionalities are in use. However, some are also usable
in smaller multicast environments and point-to-point calls.

```
+--------+-----------------------------+-------+------------------+
| Name   | Notes                       | Level | Mux Category     |
+--------+-----------------------------+-------+------------------+
| ccm    | The attribute value MUST be | M     | IDENTICAL-PER-PT |
| fir    | same for a given codec      |       |                  |
|        | configuration               |       |                  |
|        |                             |       |                  |
| ccm    | The attribute value MUST be | M     | IDENTICAL-PER-PT |
| tmmbr  | same for a given codec      |       |                  |
|        | configuration               |       |                  |
|        |                             |       |                  |
| ccm    | The attribute value MUST be | M     | IDENTICAL-PER-PT |
| tstr   | same for a given codec      |       |                  |
|        | configuration               |       |                  |
|        |                             |       |                  |
| ccm    | The attribute value MUST be | M     | IDENTICAL-PER-PT |
| vbcm   | same for a given codec      |       |                  |
|        | configuration               |       |                  |
|        |                             |       |                  |
+--------+-----------------------------+-------+------------------+
```

7.6 RFC5104 Attribute Analysis

8. group Attribute Analysis

This section analyzes SDP "group" attribute semantics [RFC5888].

8.1. RFC5888: SDP Grouping Framework

[RFC5888] defines a framework to group "m" lines in SDP for different
purposes.

```
+------------+---------------+-------+-------------+
| Name       | Notes         | Level | Mux Category |
+------------+---------------+-------+-------------+
| group:LS   | Not Impacted  | S     | NORMAL      |
|            |               |       |             |
| group:FID  | Not Impacted  | S     | NORMAL      |
|            |               |       |             |
+------------+---------------+-------+-------------+
```

                    8.1 [RFC5888](#) Attribute Analysis

8.2. [RFC3524](#): Mapping Media Streams to Resource Reservation Flows

   [RFC3524] defines an extension to the SDP grouping framework. It
   allows requesting a group of media streams to be mapped into a single
   resource reservation flow. The SDP syntax needed is defined, as well
   as a new "semantics" attribute called Single Reservation Flow (SRF).

```
+------------+---------------+-------+-------------+
| Name       | Notes         | Level | Mux Category |
+------------+---------------+-------+-------------+
| group:SRF  | Not Impacted  | S     | NORMAL      |
|            |               |       |             |
+------------+---------------+-------+-------------+
```

                    8.2 [RFC3524](#) Attribute Analysis

8.3. [RFC4091](#): ANAT Semantics

   [RFC4091] defines ANAT semantics for the SDP grouping framework. The
   ANAT semantics allow alternative types of network addresses to
   establish a particular media stream.

```
+------------+----------------------------+-------+-------------+
| Name       | Notes                      | Level | Mux Category |
+------------+----------------------------+-------+-------------+
| group:ANAT | ANAT semantics is obsoleted | S     | CAUTION     |
|            |                            |       |             |
+------------+----------------------------+-------+-------------+
```

                    8.3 [RFC4091](#) Attribute Analysis

8.4. [RFC5956](#): FEC Grouping Semantics in SDP

   [RFC5956] defines the semantics for grouping the associated source
   and FEC-based (Forward Error Correction) repair flows in SDP. The
   semantics defined in the document are to be used with the SDP
   Grouping Framework [[RFC5888](#)]. These semantics allow the description

of grouping relationships between the source and repair flows when
one or more source and/or repair flows are associated in the same
group, and they provide support for additive repair flows. SSRC-
level (Synchronization Source) grouping semantics are also defined in
this document for RTP streams using SSRC multiplexing.

```
+--------------+--------------+-------+-------------+
| Name         | Notes        | Level | Mux Category |
+--------------+--------------+-------+-------------+
| group:FEC-FR | Not Impacted | S     | NORMAL      |
|              |              |       |             |
+--------------+--------------+-------+-------------+
```

8.4 RFC5956 Attribute Analysis

8.5. RFC5583: Signaling Media Decoding Dependency in SDP

[RFC5583] defines semantics that allow for signaling the decoding
dependency of different media descriptions with the same media type
in SDP. This is required, for example, if media data is separated
and transported in different network streams as a result of the use
of a layered or multiple descriptive media coding process.

```
+------------+--------------------------+-------+------------------+
| Name       | Notes                    | Level | Mux Category     |
+------------+--------------------------+-------+------------------+
| group:DDP  | Not Impacted             | S     | NORMAL           |
|            |                          |       |                  |
| depend lay | The attribute value MUST | M     | IDENTICAL-PER-PT |
|            | be same for a given      |       |                  |
|            | codec configuration      |       |                  |
|            |                          |       |                  |
| depend mdc | The attribute value MUST | M     | IDENTICAL-PER-PT |
|            | be same for a given      |       |                  |
|            | codec configuration      |       |                  |
|            |                          |       |                  |
+------------+--------------------------+-------+------------------+
```

8.5 RFC5583 Attribute Analysis

8.6. RFC7104: Duplication Grouping Semantics in the SDP

[RFC7104] defines the semantics for grouping redundant streams in
SDP, The semantics defined in this document are to be used with the
SDP Grouping Framework. Grouping semantics at the SSRC)level are
also defined in this document for RTP streams using SSRC
multiplexing.

```
+-----------+--------------+-------+-------------+
| Name      | Notes        | Level | Mux Category |
+-----------+--------------+-------+-------------+
| group:DUP | Not Impacted | S     | NORMAL      |
|           |              |       |             |
+-----------+--------------+-------+-------------+
```

8.6 RFC7104 Attribute Analysis

9. ssrc-group Attribute Analysis

This section analyzes "ssrc-group" semantics.

9.1. RFC5576: Source-Specific SDP Attributes

[RFC5576] defines a mechanism to describe RTP media sources, which
are identified by their synchronization source (SSRC) identifiers, in
SDP, to associate attributes with these sources, and to express
relationships among sources. It also defines several source-level
attributes that can be used to describe properties of media sources.

```
+-------------------+--------------+-------+-------------+
| Name              | Notes        | Level | Mux Category |
+-------------------+--------------+-------+-------------+
| ssrc-group:FID    | Not Impacted | SR    | NORMAL      |
|                   |              |       |             |
| ssrc-group:FEC    | Not Impacted | SR    | NORMAL      |
|                   |              |       |             |
| ssrc-group:FEC-FR | Not Impacted | SR    | NORMAL      |
|                   |              |       |             |
+-------------------+--------------+-------+-------------+
```

9.1 RFC5576 Attribute Analysis

9.2. RFC7104: Duplication Grouping Semantics in the SDP

[RFC7104] defines the semantics for grouping redundant streams in
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.

```
+-----------------+---------------+-------+--------------+
| Name            | Notes         | Level | Mux Category |
+-----------------+---------------+-------+--------------+
| ssrc-group:DUP  | Not Impacted  | SR    | NORMAL       |
|                 |               |       |              |
+-----------------+---------------+-------+--------------+
```

9.2 RFC7104 Attribute Analysis

10. QoS Mechanism Token Analysis

This section analyzes QoS tokes specified with SDP.

10.1. RFC5432: QoS Mechanism Selection in SDP

[RFC5432] defines procedures to negotiate QOS mechanisms using the
SDP offer/answer model.

```
+-------+------------------------------------+-------+------------+
| Name  | Notes                              | Level | Mux        |
|       |                                    |       | Category   |
+-------+------------------------------------+-------+------------+
| rsvp  | rsvp attribute MUST be the one that | B    | TRANSPORT  |
|       | corresponds to the "m=" line chosen |      |            |
|       | for setting up the underlying       |      |            |
|       | transport flow                      |      |            |
|       |                                    |       |            |
| nsis  | rsvp attribute MUST be the one that | B    | TRANSPORT  |
|       | corresponds to the "m=" line chosen |      |            |
|       | for setting up the underlying       |      |            |
|       | transport                          |       |            |
|       |                                    |       |            |
+-------+------------------------------------+-------+------------+
```

10.1 RFC5432 Attribute Analysis

NOTE: A single Differentiated Services Code Point (DSCP) code point
per flow being multiplexed doesn't impact multiplexing since QOS
mechanisms are signaled/scoped per flow. For scenarios that involve
having different DSCP code points for packets being transmitted over
the same 5-tuple, issues as discussed in [RFC7657] need to be taken
into consideration.

11. k= Attribute Analysis

11.1. RFC4566: SDP

[RFC4566] defines SDP that is intended for describing multimedia
sessions for the purposes of session announcement, session
invitation, and other forms of multimedia session initiation.

```
+------+------------------------------------------+-------+----------+
| Name | Notes                                    | Level | Mux      |
|      |                                          |       | Category |
+------+------------------------------------------+-------+----------+
| k=   | It is not recommended to use this        | S     | CAUTION  |
|      | attribute under multiplexing             |       |          |
|      |                                          |       |          |
+------+------------------------------------------+-------+----------+
```

             11.1 RFC4566 Attribute Analysis

12. content Attribute Analysis

12.1. RFC4796

[RFC4796] defines a new SDP media-level attribute, 'content'. The
'content' attribute defines the content of the media stream to a more
detailed level than the media description line. The sender of an SDP
session description can attach the 'content' attribute to one or more
media streams. The receiving application can then treat each media
stream differently (e.g., show it on a big or small screen) based on
its content.

```
+-----------------+---------------+-------+--------------+
| Name            | Notes         | Level | Mux Category |
+-----------------+---------------+-------+--------------+
| content:slides  | Not Impacted  | M     | NORMAL       |
|                 |               |       |              |
| content:speaker | Not Impacted  | M     | NORMAL       |
|                 |               |       |              |
| content:main    | Not Impacted  | M     | NORMAL       |
|                 |               |       |              |
| content:sl      | Not Impacted  | M     | NORMAL       |
|                 |               |       |              |
| content:alt     | Not Impacted  | M     | NORMAL       |
|                 |               |       |              |
+-----------------+---------------+-------+--------------+
```

             12.1 RFC4796 Attribute Analysis

13. Payload Formats

13.1. RFC5109: RTP Payload Format for Generic FEC

[RFC5109] describes a payload format for generic Forward Error
Correction (FEC) for media data encapsulated in RTP. It is based on
the exclusive-or (parity) operation. The payload format allows end
systems to apply protection using various protection lengths and
levels, in addition to using various protection group sizes to adapt
to different media and channel characteristics. It enables complete
recovery of the protected packets or partial recovery of the critical
parts of the payload depending on the packet loss situation.

Name	Notes	Level	Mux Category
audio/ulpfec	Not recommended for multiplexing due to reuse of SSRCs	M	CAUTION
video/ulpfec	Not recommended for multiplexing due to reuse of SSRCs	M	CAUTION
text/ulpfec	Not recommended for multiplexing due to reuse of SSRCs	M	CAUTION
application/ulpfec	Not recommended for multiplexing due to reuse of SSRCs	M	CAUTION

13.1 RFC5109 Payload Format Analysis

14. Multiplexing Considerations for Encapsulating Attributes

This sections deals with recommendations for defining the
multiplexing characteristics of the SDP attributes that encapsulate
other SDP attributes/parameters. Such attributes as of today, for
example, are defined in [RFC3407], [RFC5939] and [RFC6871] as part of
a generic framework for indicating and negotiating transport, media,
and media format related capabilities in the SDP.

The behavior of such attributes under multiplexing is in turn defined
by the multiplexing behavior of the attributes they encapsulate which

are made known once the Offer/Answer negotiation process is
completed.

14.1. RFC3407: cpar Attribute Analysis

[RFC3407] capability parameter attribute (a=cpar) encapsulates b=
(bandwidth) or an a= attribute. For bandwidth attribute
encapsulation, the category SUM is inherited. For the case of a=
attribute, the category corresponding to the SDP attribute being
encapsulated is inherited.

```
 v=0
 o=alice 2890844526 2890844527 IN IP4 host.atlanta.example.com
 s=
 c=IN IP4 host.atlanta.example.com
 t=0 0
 m=video 3456 RTP/AVP 100
 a=rtpmap:100 VP8/90000
 a=sqn: 0
 a=cdsc: 1 video RTP/AVP 100
 a=cpar: a=rtcp-mux
 m=video 3456 RTP/AVP 101
 a=rtpmap:101 VP8/90000
 a=fmtp:100 max-fr=15;max-fs=1200
 a=cdsc: 2 video RTP/AVP 101
 a=cpar: a=rtcp-mux
```

In the above example,the category IDENTICAL is inherited for the cpar
encapsulated rtcp-mux attribute.

14.2. RFC5939 Analysis

[RFC5939] defines a general SDP capability negotiation framework. It
also specifies how to provide transport protocols and SDP attributes
as capabilities and negotiate them using the framework.

For this purpose, [RFC5939] defines the following

o A set of capabilities for the session and its associated media
   stream components, supported by each side. The attribute
   ("a=acap") defines how to list an attribute name and its
   associated value (if any) as a capability. The attribute
   ("a=tcap") defines how to list transport protocols (e.g., "RTP/
   AVP") as capabilities.

o A set of potential configurations ("a=pcfg") provided by the
   offerer to indicate which combinations of those capabilities can
   be used for the session and its associated media stream

components. Potential configurations are not ready for use until
fully negotiated. They provide an alternative that MAY be used,
subject to SDP capability negotiation procedures. In particular
the answerer MAY choose one of the potential configurations for
use as part of the current Offer/Answer exchange.

o An actual configuration ("a=acfg") for the session and its
associated media stream components. The actual configuration
identifies the potential configuration that was negotiated for
use. Use of an actual configuration does not require any further
negotiation.

o A negotiation process that takes the current actual and the set of
potential configurations (combinations of capabilities) as input
and provides the negotiated actual configurations as output. In
[RFC5939] the negotiation process is done independently for each
media description.

14.2.1. Recommendation: Procedures for Potential Configuration Pairing

This section provides recommendations for entities generating and
processing SDP under the generic capability negotiation framework as
defined in [RFC5939] under the context of media stream multiplexing.

These recommendations are provided for the purposes of enabling the
Offerer to make sure that the generated potential configurations
between the multiplexed streams can (easily) be negotiated to be
consistent between those streams. In particular, the procedures aim
to simplify Answerer's procedure to choose potential configurations
that are consistent across all the multiplexed media descriptions.

A potential configuration selects a set of attributes and parameters
that become part of the media description when negotiated. When
multiplexing media descriptions with potential configurations
specified, there MAY be a need for coordinating this selection
between multiplexed media descriptions to ensure the right
multiplexing behavior.

Although it is possible to analyze the various potential
configurations in multiplexed media descriptions to find combinations
that satisfy such constraints, it can quickly become complicated to
do so.

The procedures defined in [RFC5939] state that each potential
configuration in the SDP has a unique configuration number, however
the scope of uniqueness is limited to each media description. To
make it simple for the answerer to chose valid combinations of
potential configurations across media descriptions in a given bundle

group, we provide a simple rule for constructing potential
configurations

o Let m-bundle be the set of media descriptions that form a given
   bundle .

o Let m-bundle-pcfg be the set of media descriptions in m-bundle
   that include one or more potential configurations.

o Each media description in m-bundle-pcfg MUST have at least one
   potential configuration with the same configuration number (e.g.
   "1").

o For each potential configuration with configuration number x in m-
   bundle-pcfg, the offerer MUST ensure that if the answerer chooses
   configuration number x in each of the media descriptions in m-
   bundle-pcfg, then the resulting SDP will have all multiplexing
   constraints satisfied for those media descriptions.

o Since it is nearly impossible to define a generic mechanism for
   various capability extensions, this document does't provide
   procedures for dealing with the capability extension attributes.
   However, Section 14.3 provide analysis of media capability
   extension attributes as defined in [RFC6871].

The above allows the answerer to easily find multiplexing compatible
combinations of potential configurations: The answerer simply choses
a potential configuration (number) that is present in all of the
media descriptions with potential configurations in the bundle.

Note that it is still possible for the offerer to provide additional
potential configurations with independent configuration numbers. The
answerer will have to perform more complicated analysis to determine
valid multiplexed combinations of those.

14.2.1.1. Example: Transport Capability Multiplexing

```
v=0
o=alice 2890844526 2890844527 IN IP4 host.atlanta.example.com
s=
c=IN IP4 host.atlanta.example.com
t=0 0
a=tcap:1 RTP/SAVPF
a=tcap:2 RTP/SAVP
a=group:BUNDLE audio video
m=audio
a=mid:audio
a=pcfg:1 t=1
a=pcfg:2
m=video
a=mid:video
a=pcfg:1 t=1
a=pcfg:2 t=2
```

In the example above, the potential configurations that offer
transport protocol capability of RTP/SAVPF has the same configuration
number "1" in both the audio and video media descriptions.

14.2.1.2. Example: Attribute Capability Multiplexing

```
v=0
o=alice 2890844526 2890844527 IN IP4 host.atlanta.example.com
s=
c=IN IP4 host.atlanta.example.com
t=0 0
a=acap:1 a=rtcp-mux
a=acap:2 a=crypto:1 AES_CM_128_HMAC_SHA1_80
  inline:EcGZiNWpFJhQXdspcl1ekcmVCNWpVLcfHAwJSoj|2^20|1:32
a=group:BUNDLE audio video
m=audio 49172 RTP/AVP 99
a=mid:audio
a=pcfg:1 a=1
a=pcfg:2
m=video 560024 RTP/AVP 100
a=mid:video
a=pcfg:1 a=1
a=pcfg:2 a=2
```

In the example above, the potential configuration number "1" is
repeated while referring to attribute capability a=rtcp-mux, since
the behavior is IDENTICAL for the attribute a=rtcp-mux under
multiplexing.

14.3. RFC6871 Analysis

[RFC6871] extends the capability negotiation framework described in
[RFC5939] by defining media capabilities that can be used to indicate
and negotiate media types and their associated format parameters. It
also allows indication of latent configurations and session
capabilities.

14.3.1. Recommendation: Dealing with Payload Type Numbers

[RFC6871] defines a new payload type ("pt") parameter to be used with
the potential, actual, and latent configuration parameters. The
parameter associates RTP payload type numbers with the referenced
RTP-based media format capabilities ("a=rmcap") defined in [RFC6871]
and is appropriate only when the transport protocol uses RTP. This
means that the same payload type number can be assigned as part of
potential or actual configurations in different media descriptions in
a bundle. There are rules for the usage of identical Payload Type
values across multiplexed "m=" lines as described in
[I-D.ietf-mmusic-sdp-bundle-negotiation], which must be followed here
as well. As described in Section 14.2.1, the use of identical
configuration numbers for compatible configurations in different
media descriptions that are part of the bundle provides a way to
ensure that the answerer can easily pick compatible configurations
here as well.

14.3.1.1. Example: Attribute Capability Under Shared Payload Type

The attributes (a=rmcap, a=mfcap) follow the above recommendations
under multiplexing.

```
   v=0
   o=- 25678 753849 IN IP4 192.0.2.1
   s=
   c=IN IP4 192.0.2.1
   t=0 0
   a=creq:med-v0
   m=audio 54322 RTP/AVP 96
   a=rtpmap:96 AMR-WB/16000/1
   a=fmtp:96 mode-change-capability=1; max-red=220;
   mode-set=0,2,4,7
   a=rmcap:1,3 audio AMR-WB/16000/1
   a=rmcap:2 audio AMR/8000/1
   a=mfcap:1,2 mode-change-capability=1
   a=mfcap:3 mode-change-capability=2
   a=pcfg:1 m=1 pt=1:96
   a=pcfg:2 m=2 pt=2:97
   a=pcfg:3 m=3 pt=3:98
   m=audio 54322 RTP/AVP 96
   a=rtpmap:96 AMR-WB/16000/1
   a=fmtp:96 mode-change-capability=1; max-red=220;
   mode-set=0,2,4,7
   a=rmcap:4 audio AMR/8000/1
   a=rmcap:5 audio OPUS/48000/2
   a=mfcap:5 minptime=40
   a=mfcap:4 mode-change-capability=1
   a=pcfg:1 m=4 pt=4:97
   a=pcfg:4 m=5 pt=5:101
```

   In the example above, the potential configuration number "1" is
   repeated when referring to media and media format capability used for
   the Payload Type 96. This implies that both the media capability 2
   and 4 along with their media format capabilities MUST refer to the
   same codec configuration, as per the definition of IDENTICAL-PER-PT.

14.3.2. Recommendation: Dealing with Latent Configurations

   [RFC6871] adds the notion of a latent configurations, which provides
   configuration information that may be used to guide a subsequent
   offer/exchange, e.g. by adding another media stream or use
   alternative codec combinations not currently offered. Latent
   configurations have configuration numbers which cannot overlap with
   the potential configuration numbers [RFC6871]. Supported
   combinations of potential and latent configurations are indicated by
   use of the "a=sescap" attribute, however use of this attribute is not
   recommended with multiplexed media, since it requires the use of
   unique configuration numbers across the SDP. Taken together, this
   means there is no well-defined way to indicate supported combinations

of latent configurations, or combinations of latent and potential
configurations with multiplexed media. It is still allowed to use
the latent configuration attribute, however the limitations above
will apply. To determine valid combinations, actual negotiation will
have to be attempted subsequently instead.

15. IANA Considerations

[RFC EDITOR NOTE: Please replace RFCXXXX with the RFC number of this
document.]

Section 15.1 defines a new subregistry to be added by the IANA for
identifying the initial registrations for various multiplexing
categories applicable, as proposed in this document.

IANA is also requested to add a new column named "Mux Category" to
several of the subregistries in the "Session Description Protocol
(SDP) Parameters" registry. The tables in Section 15.2 identify name
of an entry in the existing subregistry and specify the value to be
put in the new "Mux Category" column of the associated IANA registry.

15.1. New 'Multiplexing Categories' subregistry

A new sub-registry needs to be defined called the "Multiplexing
Categories", with the following registrations created initially:
"NORMAL", "CAUTION", "IDENTICAL", "TRANSPORT", "SUM", "INHERIT",
"IDENTICAL-PER-PT", "SPECIAL" and "TBD" as defined in this document.

Initial value registration for "Multiplexing Categories".

```
+-------------------------+-----------+
| Multiplexing Categories | Reference |
+-------------------------+-----------+
| NORMAL                  | RFCXXXX   |
| CAUTION                 | RFCXXXX   |
| IDENTICAL               | RFCXXXX   |
| TRANSPORT               | RFCXXXX   |
| SUM                     | RFCXXXX   |
| INHERIT                 | RFCXXXX   |
| IDENTICAL-PER-PT        | RFCXXXX   |
| SPECIAL                 | RFCXXXX   |
| TBD                     | RFCXXXX   |
+-------------------------+-----------+
```

Further entries can be registered using Standard Actions policies
outlined in [RFC5226], which requires IESG review and approval and
standards-track IETF RFC publication.

Each registration needs to indicate the multiplexing category value
to be added to the "Multiplexing Categories" subregistry as defined
in this section.

Such a registration MUST also indicate the applicability of the newly
defined multiplexing category value to various subregistries defined
at the "Session Description Protocol (SDP) Parameters" registry.

15.2. 'Mux Category' column for subregistries

Each sub-section identifies a subregistry in the "Session Description
Protocol (SDP) Parameters" registry. The tables list the column that
identifies the SDP attribute name/Token/Value from the corresponding
subregistries and the values to be used for the new "Mux Category"
column to be added.

For the entries in the existing subregistries, under the "Session
Description Protocol (SDP) Parameters" registry, that lack a value
for the "Mux Category" in this specification will get a value of
"TBD".

Any future updates to the "Mux Category" column values needs to
follow the existing registration policy of the affected table
(Section 8.2.4.2 of [I-D.ietf-mmusic-rfc4566bis]).

Also, the procedures from Section 8.2.4.1 of
[I-D.ietf-mmusic-rfc4566bis] needs to be followed when assigning "Mux
Category" value for the newly defined SDP attributes.

15.2.1. Table: SDP bwtype

The following values are to be added to the 'SDP bwtype' subregistry
in the "Session Description Protocol (SDP) Parameters" registry. The
references should be updated to point at this RFC as well as the
previous references.

SDP Name	Mux Category
CT	NORMAL
AS	SUM
RS	SUM
RR	SUM
TIAS	SPECIAL

15.2.2. Table: att-field (session level)

   The following values are to be added to the "att-field (session
   level)" subregistry in the "Session Description Protocol (SDP)
   Parameters" registry. The references should be updated to point at
   this RFC as well as the previous references.

```
+---------------------+-------------+
| SDP Name            | Mux Category |
+---------------------+-------------+
| cat                 | NORMAL      |
| keywds              | NORMAL      |
| type                | NORMAL      |
| type:broadcast      | NORMAL      |
| type:H332           | NORMAL      |
| type:meeting        | NORMAL      |
| type:moderated      | NORMAL      |
| type:test           | NORMAL      |
| charset             | NORMAL      |
| charset:iso8895-1   | NORMAL      |
| tool                | NORMAL      |
| ipbcp               | SPECIAL     |
| group               | NORMAL      |
| ice-lite            | NORMAL      |
| ice-options         | NORMAL      |
| bcastversion        | NORMAL      |
| 3GPP-Integrity-Key  | CAUTION     |
| 3GPP-SDP-Auth       | CAUTION     |
| alt-group           | CAUTION     |
| PSCid               | NORMAL      |
| bc_service          | NORMAL      |
| bc_program          | NORMAL      |
| bc_service_package  | NORMAL      |
| sescap              | CAUTION     |
| rtsp-ice-d-m        | TBD         |
+---------------------+-------------+
```

15.2.3. Table: att-field (both session and media level)

   The following values are to be added to the "att-field (both session
   and media level)" subregistry in the "Session Description Protocol
   (SDP) Parameters" registry. The references should be updated to
   point at this RFC as well as the previous references.

   NOTE: The attributes from draft-ietf-rmt-flute-sdp ('flute-tsi',
   'flute-ch', 'FEC-declaration', 'FEC-OTI-extension', 'content-desc')
   were not analyzed for their multiplexing behavior due to the expired

status of the draft. For purposes of this specification, the
multiplexing category of 'TBD' is assigned.

```
+-------------------------+------------------+
| SDP Name                | Mux Category     |
+-------------------------+------------------+
| recvonly                | NORMAL           |
| sendrecv                | NORMAL           |
| sendonly                | NORMAL           |
| sdplang                 | NORMAL           |
| lang                    | NORMAL           |
| h248item                | SPECIAL          |
| sqn                     | NORMAL           |
| cdsc                    | NORMAL           |
| cpar                    | INHERIT          |
| cparmin                 | SPECIAL          |
| cparmax                 | SPECIAL          |
| rtcp-xr                 | NORMAL           |
| maxprate                | SPECIAL          |
| setup                   | TRANSPORT        |
| connection              | TRANSPORT        |
| key-mgmt                | IDENTICAL        |
| source-filter           | IDENTICAL        |
| inactive                | NORMAL           |
| fingerprint             | TRANSPORT        |
| flute-tsi               | TBD              |
| flute-ch                | TBD              |
| FEC-declaration         | TBD              |
| FEC-OTI-extension       | TBD              |
| content-desc            | TBD              |
| ice-pwd                 | TRANSPORT        |
| ice-ufrag               | TRANSPORT        |
| stkmstream              | NORMAL           |
| extmap                  | SPECIAL          |
| qos-mech-send           | TRANSPORT        |
| qos-mech-recv           | TRANSPORT        |
| csup                    | NORMAL           |
| creq                    | NORMAL           |
| acap                    | INHERIT          |
| tcap                    | INHERIT          |
| 3GPP-QoE-Metrics        | CAUTION          |
| 3GPP-Asset-Information  | CAUTION          |
| mbms-mode               | CAUTION          |
| mbms-repair             | CAUTION          |
| ike-setup               | IDENTICAL        |
| psk-fingerprint         | IDENTICAL        |
| multicast-rtcp          | IDENTICAL        |
| rmcap                   | IDENTICAL-PER-PT |
```

```
| omcap                   | NORMAL            |
| mfcap                   | IDENTICAL-PER-PT  |
| mscap                   | INHERIT           |
| 3gpp.iut.replication    | TBD               |
| bcap                    | INHERIT           |
| ccap                    | IDENTICAL         |
| icap                    | NORMAL            |
| 3gpp_sync_info          | NORMAL            |
| 3gpp_MaxRecvSDUSize     | NORMAL            |
| etag                    | CAUTION           |
| duplication-delay       | NORMAL            |
| range                   | CAUTION           |
| control                 | CAUTION           |
| mtag                    | CAUTION           |
| ts-refclk               | NORMAL            |
| mediaclk                | NORMAL            |
| calgextmap              | NORMAL            |
+-------------------------+-------------------+
```

15.2.4. Table: att-field (media level only)

The following values are to be added to the "att-field (media level
only)" registry in the "Session Description Protocol (SDP)
Parameters" registry. The references should be updated to point at
this RFC as well as the previous references.

```
+----------------------------+-------------------+
| SDP Name                   | Mux Category      |
+----------------------------+-------------------+
| ptime                      | IDENTICAL-PER-PT  |
| orient                     | NORMAL            |
| orient:portrait            | NORMAL            |
| orient:landscape           | NORMAL            |
| orient:seascape            | NORMAL            |
| framerate                  | IDENTICAL-PER-PT  |
| quality                    | NORMAL            |
| rtpmap                     | IDENTICAL-PER-PT  |
| fmtp                       | IDENTICAL-PER-PT  |
| rtpred1                    | CAUTION           |
| rtpred2                    | CAUTION           |
| T38FaxVersion              | TBD               |
| T38MaxBitRate              | TBD               |
| T38FaxFillBitRemoval       | TBD               |
| T38FaxTranscodingMMR       | TBD               |
| T38FaxTranscodingJBIG      | TBD               |
| T38FaxRateManagement       | TBD               |
| T38FaxMaxBuffer            | TBD               |
| T38FaxMaxDatagram          | TBD               |
```

T38FaxUdpEC	TBD	
maxptime	IDENTICAL-PER-PT	
des	CAUTION	
curr	CAUTION	
conf	CAUTION	
mid	NORMAL	
rtcp	TRANSPORT	
rtcp-fb	IDENTICAL-PER-PT	
label	NORMAL	
T38VendorInfo	TBD	
crypto	TRANSPORT	
eecid	CAUTION	
aalType	CAUTION	
capability	CAUTION	
qosClass	CAUTION	
bcob	CAUTION	
stc	CAUTION	
upcc	CAUTION	
atmQOSparms	CAUTION	
atmTrfcDesc	CAUTION	
abrParms	CAUTION	
abrSetup	CAUTION	
bearerType	CAUTION	
lij	CAUTION	
anycast	CAUTION	
cache	CAUTION	
bearerSigIE	CAUTION	
aalApp	CAUTION	
cbrRate	CAUTION	
sbc	CAUTION	
clkrec	CAUTION	
fec	CAUTION	
prtfl	CAUTION	
structure	CAUTION	
cpsSDUsize	CAUTION	
all2CPS	CAUTION	
all2CPSSDUrate	CAUTION	
aal2sscs3661unassured	CAUTION	
aal2sscs3661assured	CAUTION	
aal2sscs3662	CAUTION	
aal5sscop	CAUTION	
atmmap	CAUTION	
silenceSupp	CAUTION	
ecan	CAUTION	
gc	CAUTION	
profileDesc	CAUTION	
vsel	CAUTION	
dsel	CAUTION	

fsel	CAUTION	
onewaySel	CAUTION	
codecconfig	CAUTION	
isup_usi	CAUTION	
uiLayer1_Prot	CAUTION	
chain	CAUTION	
floorctrl	IDENTICAL	
confid	NORMAL	
userid	NORMAL	
floorid	NORMAL	
FEC	NORMAL	
accept-types	TBD	
accept-wrapped-types	TBD	
max-size	TBD	
path	TBD	
dccp-service-code	CAUTION	
rtcp-mux	IDENTICAL	
candidate	TRANSPORT	
ice-mismatch	NORMAL	
remote-candidates	TRANSPORT	
SRTPAuthentication	TBD	
SRTPROCTxRate	TBD	
rtcp-rsize	IDENTICAL	
file-selector	TBD	
file-transfer-id	TBD	
file-disposition	TBD	
file-date	TBD	
file-icon	TBD	
file-range	TBD	
depend	IDENTICAL-PER-PT	
ssrc	NORMAL	
ssrc-group	NORMAL	
rtcp-unicast	IDENTICAL	
pcfg	SPECIAL	
acfg	SPECIAL	
zrtp-hash	TRANSPORT	
X-predecbufsize	CAUTION	
X-initpredecbufperiod	CAUTION	
X-initpostdecbufperiod	CAUTION	
X-decbyterate	CAUTION	
3gpp-videopostdecbufsize	CAUTION	
framesize	CAUTION	
3GPP-SRTP-Config	CAUTION	
alt	CAUTION	
alt-default-id	CAUTION	
3GPP-Adaption-Support	CAUTION	
mbms-flowid	CAUTION	
fec-source-flow	SPECIAL	

```
| fec-repair-flow        | SPECIAL          |
| repair-window          | SPECIAL          |
| rams-updates           | CAUTION          |
| imageattr              | IDENTICAL-PER-PT |
| cfw-id                 | NORMAL           |
| portmapping-req        | CAUTION          |
| g.3gpp.cat             | NORMAL           |
| g.3gpp.crs             | NORMAL           |
| ecn-capable-rtp        | IDENTICAL        |
| visited-realm          | TRANSPORT        |
| secondary-realm        | TRANSPORT        |
| omr-s-cksum            | NORMAL           |
| omr-m-cksum            | NORMAL           |
| omr-codecs             | NORMAL           |
| omr-m-att              | NORMAL           |
| omr-s-att              | NORMAL           |
| omr-m-bw               | NORMAL           |
| omr-s-bw               | NORMAL           |
| msrp-cema              | TBD              |
| dccp-port              | CAUTION          |
| resource               | NORMAL           |
| channel                | NORMAL           |
| cmid                   | NORMAL           |
| content                | NORMAL           |
| lcfg                   | SPECIAL          |
| loopback               | NORMAL           |
| loopback-source        | NORMAL           |
| loopback-mirror        | NORMAL           |
| chatroom               | TBD              |
| altc                   | TRANSPORT        |
| T38FaxMaxIFP           | TBD              |
| T38FaxUdpECDepth       | TBD              |
| T38FaxUdpFECMaxSpan    | TBD              |
| T38ModemType           | TBD              |
| cs-correlation         | TBD              |
| rtcp-idms              | NORMAL           |
+------------------------+------------------+
```

15.2.5. Table: att-field (source level)

The following values are to be added to the "att-field (source
level)" registry in the "Session Description Protocol (SDP)
Parameters" registry. The references should be updated to point at
this RFC as well as the previous references.

```
+----------------+-------------------+
| SDP Name       | Mux Category      |
+----------------+-------------------+
| cname          | NORMAL            |
| previous-ssrc  | NORMAL            |
| fmtp           | IDENTICAL-PER-PT  |
| ts-refclk      | NORMAL            |
| mediaclk       | NORMAL            |
+----------------+-------------------+
```

15.2.6. Table: content SDP Parameters

The following values are to be added to the "content SDP Parameters"
subregistry in the "Session Description Protocol (SDP) Parameters"
registry. The references should be updated to point at this RFC as
well as the previous references.

```
+----------+--------------+
| SDP Name | Mux Category |
+----------+--------------+
| slides   | NORMAL       |
| speaker  | NORMAL       |
| sl       | NORMAL       |
| main     | NORMAL       |
| alt      | NORMAL       |
+----------+--------------+
```

15.2.7. Table: Semantics for the 'group' SDP Attribute

The following values are to be added to the "Semantics for the
"group" SDP Attribute" subregistry in the "Session Description
Protocol (SDP) Parameters" registry. The references should be
updated to point at this RFC as well as the previous references.

```
+---------+--------------+
| Token   | Mux Category |
+---------+--------------+
| LS      | NORMAL       |
| FID     | NORMAL       |
| SRF     | NORMAL       |
| ANAT    | CAUTION      |
| FEC     | NORMAL       |
| FEC-FR  | NORMAL       |
| CS      | NORMAL       |
| DDP     | NORMAL       |
| DUP     | NORMAL       |
+---------+--------------+
```

15.2.8. Table: 'rtcp-fb' Attribute Values

   The following values are to be added to the " 'rtcp-fb' Attribute
   Values" subregistry in the "Session Description Protocol (SDP)
   Parameters" registry. The references should be updated to point at
   this RFC as well as the previous references.

   +------------+-------------------+
   | Value Name | Mux Category |
   +------------+-------------------+
ack	IDENTICAL-PER-PT
app	SPECIAL
ccm	IDENTICAL-PER-PT
nack	IDENTICAL-PER-PT
trr-int	IDENTICAL-PER-PT
   +------------+-------------------+

15.2.9. Table: 'ack' and 'nack' Attribute Values

   The following values are to be added to the " 'ack' and 'nack'
   Attribute Values" subregistry in the "Session Description Protocol
   (SDP) Parameters" registry. The references should be updated to
   point at this RFC as well as the previous references.

   +------------+-------------------+
   | Value Name | Mux Category |
   +------------+-------------------+
sli	IDENTICAL-PER-PT
pli	IDENTICAL-PER-PT
rpsi	IDENTICAL-PER-PT
app	SPECIAL
rai	IDENTICAL-PER-PT
tllei	IDENTICAL-PER-PT
pslei	IDENTICAL-PER-PT
ecn	IDENTICAL
   +------------+-------------------+

15.2.10. Table: 'depend' SDP Attribute Values

   The following values are to be added to the " 'depend' SDP Attribute
   Values" subregistry in the "Session Description Protocol (SDP)
   Parameters" registry. The references should be updated to point at
   this RFC as well as the previous references.

```
+-------+------------------+
| Token | Mux Category     |
+-------+------------------+
| lay   | IDENTICAL-PER-PT |
| mdc   | IDENTICAL-PER-PT |
+-------+------------------+
```

15.2.11. **Table: 'cs-correlation' Attribute Values**

The following values are to be added to the " "cs-correlation"
Attribute Values" subregistry in the "Session Description Protocol
(SDP) Parameters" registry. The references should be updated to
point at this RFC as well as the previous references.

```
+-----------+--------------+
| Value     | Mux Category |
+-----------+--------------+
| callerid  | TBD          |
| uuie      | TBD          |
| dtmf      | TBD          |
| external  | TBD          |
+-----------+--------------+
```

15.2.12. **Table: Semantics for the 'ssrc-group' SDP Attribute**

The following values are to be added to the Semantics for the
"Semantics for the "ssrc-group" SDP Attribute" subregistry in the
"Session Description Protocol (SDP) Parameters" registry. The
references should be updated to point at this RFC as well as the
previous references.

```
+---------+--------------+
| Token   | Mux Category |
+---------+--------------+
| FID     | NORMAL       |
| FEC     | NORMAL       |
| FEC-FR  | NORMAL       |
| DUP     | NORMAL       |
+---------+--------------+
```

15.2.13. **Table: SDP/RTSP key management protocol identifiers**

The following values are to be added to the "SDP/RTSP key management
protocol identifiers" subregistry in the "Session Description
Protocol (SDP) Parameters" registry. The references should be
updated to point at this RFC as well as the previous references.

```
+------------+--------------+
| Value Name | Mux Category |
+------------+--------------+
| mikey      | IDENTICAL    |
+------------+--------------+
```

15.2.14. Table: Codec Control Messages

The following values are to be added to the "Codec Control Messages"
subregistry in the "Session Description Protocol (SDP) Parameters"
registry. The references should be updated to point at this RFC as
well as the previous references.

```
+------------+-------------------+
| Value Name | Mux Category      |
+------------+-------------------+
| fir        | IDENTICAL-PER-PT  |
| tmmbr      | IDENTICAL-PER-PT  |
| tstr       | IDENTICAL-PER-PT  |
| vbcm       | IDENTICAL-PER-PT  |
+------------+-------------------+
```

15.2.15. Table: QoS Mechanism Tokens

The following values are to be added to the "QoS Mechanism Tokens"
subregistry in the "Session Description Protocol (SDP) Parameters"
registry. The references should be updated to point at this RFC as
well as the previous references.

```
+---------------+--------------+
| QoS Mechanism | Mux Category |
+---------------+--------------+
| rsvp          | TRANSPORT    |
| nsis          | TRANSPORT    |
+---------------+--------------+
```

15.2.16. Table: SDP Capability Negotiation Option Tags

The following values are to be added to the "SDP Capability
Negotiation Option Tags" subregistry in the "Session Description
Protocol (SDP) Parameters" registry. The references should be
updated to point at this RFC as well as the previous references.

```
+------------+--------------+
| Option Tag | Mux Category |
+------------+--------------+
| cap-v0     | NORMAL       |
| med-v0     | NORMAL       |
| bcap-v0    | NORMAL       |
| ccap-v0    | NORMAL       |
| icap-v0    | NORMAL       |
+------------+--------------+
```

15.2.17. Table: Timestamp Reference Clock Source Parameters

   The following values are to be added to the "Timestamp Reference
   Clock Source Parameters" subregistry in the "Session Description
   Protocol (SDP) Parameters" registry. The references should be
   updated to point at this RFC as well as the previous references.

```
+----------+--------------+
| Name     | Mux Category |
+----------+--------------+
| ntp      | NORMAL       |
| ptp      | NORMAL       |
| gps      | NORMAL       |
| gal      | NORMAL       |
| glonass  | NORMAL       |
| local    | NORMAL       |
| private  | NORMAL       |
+----------+--------------+
```

15.2.18. Table: Media Clock Source Parameters

   The following values are to be added to the "Media Clock Source
   Parameters" subegistry in the "Session Description Protocol (SDP)
   Parameters" registry. The references should be updated to point at
   this RFC as well as the previous references.

```
+-----------+--------------+
| Name      | Mux Category |
+-----------+--------------+
| sender    | NORMAL       |
| direct    | NORMAL       |
| IEEE1722  | NORMAL       |
+-----------+--------------+
```

16. Security Considerations

This document does not add any new security considerations beyond the existing considerations in the RTP RFCs ([RFC3550] and [RFC3711]) that are referenced by this specification.

The primary security for RTP including the way it is used here is described in [RFC3550] and [RFC3711].

When multiplexing SDP attributes with the category "CAUTION", the implementations should be aware of possible issues as described in this specification.

17. Acknowledgments

I would like to thank Cullen Jennings, Flemming Andreasen for suggesting the categories, contributing text and reviewing the draft. I would also link to thank Magnus Westerlund, Christer Holmberg, Jonathan Lennox, Bo Burman, Ari Keranen, and Dan Wing on suggesting structural changes helping improve the document readability.

I would like also to thank following experts on their inputs and reviews as listed - Flemming Andreasen(5.24,5.32,5.33,14), Rohan Mahy(5.57), Eric Burger(5.26),Christian Huitema(5.14), Christer Holmberg(5.21,5.26,5.51,5.52), Richard Ejzak (5.44,5.53,5.54), Colin Perkins(5.7,5.8,5.9,5.58), Magnus Westerlund(5.2,5.3,5.9,5.27,5.47,6.1,6.2,6.3,8.3,7), Roni Evens(5.12,5.27,8.4), Subha Dhesikan(5.6,10), Dan Wing(5.7,5.12,5.35,5.39,5.45), Cullen Jennings (5.40), Ali C Begen(5.1,5.20,5.22,5.25,5.38,7.3,8.2,8.4,8.6,9.2,13.1), Bo Burman (7.2,7.6), Charles Eckel(5.15,5.27,5.28,9.1,8.5), Paul Kyzivat(5.24), Ian Johansson(5.15), Saravanan Shanmugham(5.11), Paul E Jones(5.30), Rajesh Kumar(5.48), Jonathan Lennox(5.36,5,15,9.1,11.1), Mo Zanaty(5.4,5.5,5.23,8.1,8.3,8.5,12.1), Christian Huitema (5.14), Qin Wu (5.47 PM-Dir review), Hans Stokking(5.43,5.16), Christian Groves (5.48,5.55), Thomas Stach.

I would like to thank Chris Lonvick for the SECDIR review, Dan Romascanu for th Gen-ART review and Sabrina Tanamal for the IANA review.

Thanks to Ben Campbell for AD review suggestions.

18. Change Log

[RFC EDITOR NOTE: Please remove this section when publishing]

Changes from draft-ietf-mmusic-sdp-mux-attributes-10 - draft-ietf-mmusic-sdp-mux-attributes-13

o Incorporated Comments from WGLC review and AD Evaluation

Changes from draft-ietf-mmusic-sdp-mux-attributes-10

o Incorporated Comments from Bo Burman for publication request

Changes from draft-ietf-mmusic-sdp-mux-attributes-08 to draft-ietf-mmusic-sdp-mux-attributes-10

o Minor nits and version update to advert expiration

Changes from draft-ietf-mmusic-sdp-mux-attributes-06 to draft-ietf-mmusic-sdp-mux-attributes-08

o Assigned TBD category to all the attributes for whom there exists
   no specification on multiplexing behavior over the underlying
   transport protocol today.

o Incorporated comments from Flemming and Ari (post last call)

Changes from draft-ietf-mmusic-sdp-mux-attributes-06

o Incorporated last call review comments from Thomas Stach and Ari
   Keranen.

o Fixed more nits to prep for the LastCall.

Changes from draft-ietf-mmusic-sdp-mux-attributes-05

o Incorporated review comments from Christian Grooves and Ari
   Keranen.

o Fixed more nits to prep for the LastCall.

Changes from draft-ietf-mmusic-sdp-mux-attributes-04

o Fixed minor nits overall.

o Updated Acknowledgement Sections

o Last Call Version.

Changes from draft-ietf-mmusic-sdp-mux-attributes-03

o More re-work on the IANA section.

o Clean ups preparing for the last call.

   Changes from draft-ietf-mmusic-sdp-mux-attributes-02

o Incorporated suggestions from Flemming on Capability Negotiation.

o Closed open issues from IETF90

o Added IANA section to list the categories for all the SDP
   attributes anlayzed

o Lots of cleanup

o Reformatted Refernces section to use short-form notation

   Changes from draft-ietf-mmusic-sdp-mux-attributes-01

o Updated section 15 to provide detailed recommendation on dealing
   with encapsulating attributes. Also updated sections 5.20, 5.28,
   5.29 to refer to Section 15.

o Added new categories IDENTICAL-PER-PT and INHERIT

o Updated Sections 16 to add the new categories.

o Updated Sections 5.1, 5.14, 5.15, 5.38, 8.5 to reflect the
   category IDENTICAL-PER-PT.

o Reformatted section 4 to add individual categories to their own
   sections.

   Changes from draft-ietf-mmusic-sdp-mux-attributes-00

o Added Section 15 to provide recommendations on multiplexing SDP
   encapsulating attributes. Also updated sections 5.20, 5.28, 5.29
   to refer to Section 15.

o Updated Section 5.38 to incorporate PM-dir review inputs from Qin
   Wu

o Updated Sections 5.2,5.14,8.5 to refer to BUNDLE draft for more
   clarity.

o Fixed few nits regarding sentence clarity and fill-in the NOTES
   section where information was lacking.

   Changes from draft-nandakumar-mmusic-mux-attributes-05

o Renamed the document to be a WG document.

o Added [Section 14](#).

o Updated Open Issues based on IETF88 discussions.

Changes from [draft-nandakumar-mmusic-mux-attributes-04](#)

o Added few OPEN ISSUES that needs to be discussed.

o Updated sections [5.10](#),5.23,5,24,5,25,7.2,9.1,5.12,5.27,8.4,
   5.44,5.11,5.4,5.19,10.1,10.5,5.21,10.4,15.1

o Updated Table Column name Current to Level and improved TRANSPORT
   category explanation on suggestions form Dan Wing.

o Grouped all the rtcp-fb attribute analysis under a single section
   as suggested by Magnus/

Changes from [draft-nandakumar-mmusic-mux-attributes-03](#)

o Maintenance change to clean up grammatical nits and wordings.

Changes from [draft-nandakumar-mmusic-mux-attributes-02](#)

o Updated Sections [5.3](#),5.5,5.6,5.7,5.9,5.8,5.11,5.13,5.22,5.34,
   5.37,5.40,5.41,5.42,5.43,5.44,5.45,6.1,6.2,6.3,8,3,12.1 based on
   the inputs from the respective RFC Authors.

Changes from [draft-nandakumar-mmusic-mux-attributes-01](#)

o Replaced Category BAD with NOT-RECOMMENDED.

o Added Category TBD.

o Updated IANA Consideration Section.

Changes from [draft-nandakumar-mmusic-mux-attributes-00](#)

o Added new section for dealing with FEC payload types.

[19](#). References

[19.1](#). Normative References

   [I-D.ietf-mmusic-rfc4566bis]
              Handley, M., Jacobson, V., Perkins, C., and A. Begen,
              "SDP: Session Description Protocol", draft-ietf-mmusic-
              rfc4566bis-17 (work in progress), June 2016.

   [I-D.ietf-mmusic-sdp-bundle-negotiation]
              Holmberg, C., Alvestrand, H., and C. Jennings,
              "Negotiating Media Multiplexing Using the Session
              Description Protocol (SDP)", draft-ietf-mmusic-sdp-bundle-
              negotiation-24 (work in progress), January 2016.

   [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
              Requirement Levels", BCP 14, RFC 2119, March 1997.

   [RFC4566] Handley, M., Jacobson, V., and C. Perkins, "SDP: Session
              Description Protocol", RFC 4566, DOI 10.17487/RFC4566,
              July 2006, <http://www.rfc-editor.org/info/rfc4566>.

   [RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an
              IANA Considerations Section in RFCs", BCP 26, RFC 5226,
              DOI 10.17487/RFC5226, May 2008,
              <http://www.rfc-editor.org/info/rfc5226>.

19.2. Informative References

   [H.248.15]
              "Gateway control protocol: SDP H.248 package attribute",
              <http://www.itu.int/rec/T-REC-H.248.15>.

   [IANA]   "Session Description Protocol (SDP) Parameters",
              <http://www.iana.org/assignments/sdp-parameters/
              sdp-parameters.xml>.

   [Q.1970]   "Q.1970 : BICC IP bearer control protocol",
              <https://www.itu.int/rec/T-REC-Q.1970-200609-I/en>.

   [R3GPPTS183.063]
              "TISPAN - IMS based ITPV Stage 3 specification.",
              <http://www.etsi.org/deliver/
              etsi_ts/183000_183099/183063/02.01.00_60/
              ts_183063v020100p.pdf>.

   [R3GPPTS24.182]
              "IP Multimedia Subsystem (IMS) Customized Alerting Tones
              (CAT); Protocol specification",
              <http://www.3gpp.org/ftp/Specs/html-info/24182.htm>.

   [R3GPPTS24.183]
             "IP Multimedia Subsystem (IMS) Customized Ringing Signal
             (CRS); Protocol specification",
             <http://www.3gpp.org/ftp/Specs/html-info/24183.htm>.

   [R3GPPTS24.229]
             "IP multimedia call control protocol based on Session
             Initiation Protocol (SIP) and Session Description Protocol
             (SDP);",
             <http://www.3gpp.org/ftp/Specs/html-info/24229.htm>.

   [R3GPPTS26.114]
             "IP multimedia Subsystem : Media Handling and
             interaction", <http://www.3gpp.org/DynaReport/26114.htm>.

   [RFC2326] Schulzrinne, H., Rao, A., and R. Lanphier, "Real Time
             Streaming Protocol (RTSP)", RFC 2326, DOI 10.17487/
             RFC2326, April 1998,
             <http://www.rfc-editor.org/info/rfc2326>.

   [RFC3108] Kumar, R. and M. Mostafa, "Conventions for the use of the
             Session Description Protocol (SDP) for ATM Bearer
             Connections", RFC 3108, DOI 10.17487/RFC3108, May 2001,
             <http://www.rfc-editor.org/info/rfc3108>.

   [RFC3264] Rosenberg, J. and H. Schulzrinne, "An Offer/Answer Model
             with Session Description Protocol (SDP)", RFC 3264, DOI
             10.17487/RFC3264, June 2002,
             <http://www.rfc-editor.org/info/rfc3264>.

   [RFC3312] Camarillo, G., Ed., Marshall, W., Ed., and J. Rosenberg,
             "Integration of Resource Management and Session Initiation
             Protocol (SIP)", RFC 3312, DOI 10.17487/RFC3312, October
             2002, <http://www.rfc-editor.org/info/rfc3312>.

   [RFC3407] Andreasen, F., "Session Description Protocol (SDP) Simple
             Capability Declaration", RFC 3407, DOI 10.17487/RFC3407,
             October 2002, <http://www.rfc-editor.org/info/rfc3407>.

   [RFC3524] Camarillo, G. and A. Monrad, "Mapping of Media Streams to
             Resource Reservation Flows", RFC 3524, DOI 10.17487/
             RFC3524, April 2003,
             <http://www.rfc-editor.org/info/rfc3524>.

   [RFC3550] Schulzrinne, H., Casner, S., Frederick, R., and V.
             Jacobson, "RTP: A Transport Protocol for Real-Time
             Applications", STD 64, RFC 3550, DOI 10.17487/RFC3550,
             July 2003, <http://www.rfc-editor.org/info/rfc3550>.

   [RFC3556] Casner, S., "Session Description Protocol (SDP) Bandwidth
              Modifiers for RTP Control Protocol (RTCP) Bandwidth", RFC
              3556, DOI 10.17487/RFC3556, July 2003,
              <http://www.rfc-editor.org/info/rfc3556>.

   [RFC3605] Huitema, C., "Real Time Control Protocol (RTCP) attribute
              in Session Description Protocol (SDP)", RFC 3605, DOI
              10.17487/RFC3605, October 2003,
              <http://www.rfc-editor.org/info/rfc3605>.

   [RFC3611] Friedman, T., Ed., Caceres, R., Ed., and A. Clark, Ed.,
              "RTP Control Protocol Extended Reports (RTCP XR)", RFC
              3611, DOI 10.17487/RFC3611, November 2003,
              <http://www.rfc-editor.org/info/rfc3611>.

   [RFC3711] Baugher, M., McGrew, D., Naslund, M., Carrara, E., and K.
              Norrman, "The Secure Real-time Transport Protocol (SRTP)",
              RFC 3711, DOI 10.17487/RFC3711, March 2004,
              <http://www.rfc-editor.org/info/rfc3711>.

   [RFC3890] Westerlund, M., "A Transport Independent Bandwidth
              Modifier for the Session Description Protocol (SDP)", RFC
              3890, DOI 10.17487/RFC3890, September 2004,
              <http://www.rfc-editor.org/info/rfc3890>.

   [RFC4091] Camarillo, G. and J. Rosenberg, "The Alternative Network
              Address Types (ANAT) Semantics for the Session Description
              Protocol (SDP) Grouping Framework", RFC 4091, DOI
              10.17487/RFC4091, June 2005,
              <http://www.rfc-editor.org/info/rfc4091>.

   [RFC4145] Yon, D. and G. Camarillo, "TCP-Based Media Transport in
              the Session Description Protocol (SDP)", RFC 4145, DOI
              10.17487/RFC4145, September 2005,
              <http://www.rfc-editor.org/info/rfc4145>.

   [RFC4567] Arkko, J., Lindholm, F., Naslund, M., Norrman, K., and E.
              Carrara, "Key Management Extensions for Session
              Description Protocol (SDP) and Real Time Streaming
              Protocol (RTSP)", RFC 4567, DOI 10.17487/RFC4567, July
              2006, <http://www.rfc-editor.org/info/rfc4567>.

   [RFC4568] Andreasen, F., Baugher, M., and D. Wing, "Session
              Description Protocol (SDP) Security Descriptions for Media
              Streams", RFC 4568, DOI 10.17487/RFC4568, July 2006,
              <http://www.rfc-editor.org/info/rfc4568>.

   [RFC4570] Quinn, B. and R. Finlayson, "Session Description Protocol
              (SDP) Source Filters", RFC 4570, DOI 10.17487/RFC4570,
              July 2006, <http://www.rfc-editor.org/info/rfc4570>.

   [RFC4572] Lennox, J., "Connection-Oriented Media Transport over the
              Transport Layer Security (TLS) Protocol in the Session
              Description Protocol (SDP)", RFC 4572, DOI 10.17487/
              RFC4572, July 2006,
              <http://www.rfc-editor.org/info/rfc4572>.

   [RFC4574] Levin, O. and G. Camarillo, "The Session Description
              Protocol (SDP) Label Attribute", RFC 4574, DOI 10.17487/
              RFC4574, August 2006,
              <http://www.rfc-editor.org/info/rfc4574>.

   [RFC4583] Camarillo, G., "Session Description Protocol (SDP) Format
              for Binary Floor Control Protocol (BFCP) Streams", RFC
              4583, DOI 10.17487/RFC4583, November 2006,
              <http://www.rfc-editor.org/info/rfc4583>.

   [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, DOI
              10.17487/RFC4585, July 2006,
              <http://www.rfc-editor.org/info/rfc4585>.

   [RFC4796] Hautakorpi, J. and G. Camarillo, "The Session Description
              Protocol (SDP) Content Attribute", RFC 4796, DOI 10.17487/
              RFC4796, February 2007,
              <http://www.rfc-editor.org/info/rfc4796>.

   [RFC4975] Campbell, B., Ed., Mahy, R., Ed., and C. Jennings, Ed.,
              "The Message Session Relay Protocol (MSRP)", RFC 4975, DOI
              10.17487/RFC4975, September 2007,
              <http://www.rfc-editor.org/info/rfc4975>.

   [RFC5104] Wenger, S., Chandra, U., Westerlund, M., and B. Burman,
              "Codec Control Messages in the RTP Audio-Visual Profile
              with Feedback (AVPF)", RFC 5104, DOI 10.17487/RFC5104,
              February 2008, <http://www.rfc-editor.org/info/rfc5104>.

   [RFC5109] Li, A., Ed., "RTP Payload Format for Generic Forward Error
              Correction", RFC 5109, DOI 10.17487/RFC5109, December
              2007, <http://www.rfc-editor.org/info/rfc5109>.

   [RFC5159] Dondeti, L., Ed. and A. Jerichow, "Session Description
              Protocol (SDP) Attributes for Open Mobile Alliance (OMA)
              Broadcast (BCAST) Service and Content Protection", RFC
              5159, DOI 10.17487/RFC5159, March 2008,
              <http://www.rfc-editor.org/info/rfc5159>.

   [RFC5245] Rosenberg, J., "Interactive Connectivity Establishment
              (ICE): A Protocol for Network Address Translator (NAT)
              Traversal for Offer/Answer Protocols", RFC 5245, DOI
              10.17487/RFC5245, April 2010,
              <http://www.rfc-editor.org/info/rfc5245>.

   [RFC5285] Singer, D. and H. Desineni, "A General Mechanism for RTP
              Header Extensions", RFC 5285, DOI 10.17487/RFC5285, July
              2008, <http://www.rfc-editor.org/info/rfc5285>.

   [RFC5432] Polk, J., Dhesikan, S., and G. Camarillo, "Quality of
              Service (QoS) Mechanism Selection in the Session
              Description Protocol (SDP)", RFC 5432, DOI 10.17487/
              RFC5432, March 2009,
              <http://www.rfc-editor.org/info/rfc5432>.

   [RFC5506] Johansson, I. and M. Westerlund, "Support for Reduced-Size
              Real-Time Transport Control Protocol (RTCP): Opportunities
              and Consequences", RFC 5506, DOI 10.17487/RFC5506, April
              2009, <http://www.rfc-editor.org/info/rfc5506>.

   [RFC5547] Garcia-Martin, M., Isomaki, M., Camarillo, G., Loreto, S.,
              and P. Kyzivat, "A Session Description Protocol (SDP)
              Offer/Answer Mechanism to Enable File Transfer", RFC 5547,
              DOI 10.17487/RFC5547, May 2009,
              <http://www.rfc-editor.org/info/rfc5547>.

   [RFC5576] Lennox, J., Ott, J., and T. Schierl, "Source-Specific
              Media Attributes in the Session Description Protocol
              (SDP)", RFC 5576, DOI 10.17487/RFC5576, June 2009,
              <http://www.rfc-editor.org/info/rfc5576>.

   [RFC5583] Schierl, T. and S. Wenger, "Signaling Media Decoding
              Dependency in the Session Description Protocol (SDP)", RFC
              5583, DOI 10.17487/RFC5583, July 2009,
              <http://www.rfc-editor.org/info/rfc5583>.

   [RFC5760] Ott, J., Chesterfield, J., and E. Schooler, "RTP Control
              Protocol (RTCP) Extensions for Single-Source Multicast
              Sessions with Unicast Feedback", RFC 5760, DOI 10.17487/
              RFC5760, February 2010,
              <http://www.rfc-editor.org/info/rfc5760>.

   [RFC5761] Perkins, C. and M. Westerlund, "Multiplexing RTP Data and
              Control Packets on a Single Port", RFC 5761, DOI 10.17487/
              RFC5761, April 2010,
              <http://www.rfc-editor.org/info/rfc5761>.

   [RFC5762] Perkins, C., "RTP and the Datagram Congestion Control
              Protocol (DCCP)", RFC 5762, DOI 10.17487/RFC5762, April
              2010, <http://www.rfc-editor.org/info/rfc5762>.

   [RFC5763] Fischl, J., Tschofenig, H., and E. Rescorla, "Framework
              for Establishing a Secure Real-time Transport Protocol
              (SRTP) Security Context Using Datagram Transport Layer
              Security (DTLS)", RFC 5763, DOI 10.17487/RFC5763, May
              2010, <http://www.rfc-editor.org/info/rfc5763>.

   [RFC5888] Camarillo, G. and H. Schulzrinne, "The Session Description
              Protocol (SDP) Grouping Framework", RFC 5888, DOI
              10.17487/RFC5888, June 2010,
              <http://www.rfc-editor.org/info/rfc5888>.

   [RFC5939] Andreasen, F., "Session Description Protocol (SDP)
              Capability Negotiation", RFC 5939, DOI 10.17487/RFC5939,
              September 2010, <http://www.rfc-editor.org/info/rfc5939>.

   [RFC5956] Begen, A., "Forward Error Correction Grouping Semantics in
              the Session Description Protocol", RFC 5956, DOI 10.17487/
              RFC5956, September 2010,
              <http://www.rfc-editor.org/info/rfc5956>.

   [RFC6064] Westerlund, M. and P. Frojdh, "SDP and RTSP Extensions
              Defined for 3GPP Packet-Switched Streaming Service and
              Multimedia Broadcast/Multicast Service", RFC 6064, DOI
              10.17487/RFC6064, January 2011,
              <http://www.rfc-editor.org/info/rfc6064>.

   [RFC6128] Begen, A., "RTP Control Protocol (RTCP) Port for Source-
              Specific Multicast (SSM) Sessions", RFC 6128, DOI
              10.17487/RFC6128, February 2011,
              <http://www.rfc-editor.org/info/rfc6128>.

   [RFC6189] Zimmermann, P., Johnston, A., Ed., and J. Callas, "ZRTP:
              Media Path Key Agreement for Unicast Secure RTP", RFC
              6189, DOI 10.17487/RFC6189, April 2011,
              <http://www.rfc-editor.org/info/rfc6189>.

   [RFC6193]   Saito, M., Wing, D., and M. Toyama, "Media Description for
               the Internet Key Exchange Protocol (IKE) in the Session
               Description Protocol (SDP)", RFC 6193, DOI 10.17487/
               RFC6193, April 2011,
               <http://www.rfc-editor.org/info/rfc6193>.

   [RFC6230]   Boulton, C., Melanchuk, T., and S. McGlashan, "Media
               Control Channel Framework", RFC 6230, DOI 10.17487/
               RFC6230, May 2011,
               <http://www.rfc-editor.org/info/rfc6230>.

   [RFC6236]   Johansson, I. and K. Jung, "Negotiation of Generic Image
               Attributes in the Session Description Protocol (SDP)", RFC
               6236, DOI 10.17487/RFC6236, May 2011,
               <http://www.rfc-editor.org/info/rfc6236>.

   [RFC6284]   Begen, A., Wing, D., and T. Van Caenegem, "Port Mapping
               between Unicast and Multicast RTP Sessions", RFC 6284, DOI
               10.17487/RFC6284, June 2011,
               <http://www.rfc-editor.org/info/rfc6284>.

   [RFC6285]   Ver Steeg, B., Begen, A., Van Caenegem, T., and Z. Vax,
               "Unicast-Based Rapid Acquisition of Multicast RTP
               Sessions", RFC 6285, DOI 10.17487/RFC6285, June 2011,
               <http://www.rfc-editor.org/info/rfc6285>.

   [RFC6364]   Begen, A., "Session Description Protocol Elements for the
               Forward Error Correction (FEC) Framework", RFC 6364, DOI
               10.17487/RFC6364, October 2011,
               <http://www.rfc-editor.org/info/rfc6364>.

   [RFC6642]   Wu, Q., Ed., Xia, F., and R. Even, "RTP Control Protocol
               (RTCP) Extension for a Third-Party Loss Report", RFC 6642,
               DOI 10.17487/RFC6642, June 2012,
               <http://www.rfc-editor.org/info/rfc6642>.

   [RFC6679]   Westerlund, M., Johansson, I., Perkins, C., O'Hanlon, P.,
               and K. Carlberg, "Explicit Congestion Notification (ECN)
               for RTP over UDP", RFC 6679, DOI 10.17487/RFC6679, August
               2012, <http://www.rfc-editor.org/info/rfc6679>.

   [RFC6714]   Holmberg, C., Blau, S., and E. Burger, "Connection
               Establishment for Media Anchoring (CEMA) for the Message
               Session Relay Protocol (MSRP)", RFC 6714, DOI 10.17487/
               RFC6714, August 2012,
               <http://www.rfc-editor.org/info/rfc6714>.

   [RFC6773] Phelan, T., Fairhurst, G., and C. Perkins, "DCCP-UDP: A
              Datagram Congestion Control Protocol UDP Encapsulation for
              NAT Traversal", RFC 6773, DOI 10.17487/RFC6773, November
              2012, <http://www.rfc-editor.org/info/rfc6773>.

   [RFC6787] Burnett, D. and S. Shanmugham, "Media Resource Control
              Protocol Version 2 (MRCPv2)", RFC 6787, DOI 10.17487/
              RFC6787, November 2012,
              <http://www.rfc-editor.org/info/rfc6787>.

   [RFC6849] Kaplan, H., Ed., Hedayat, K., Venna, N., Jones, P., and N.
              Stratton, "An Extension to the Session Description
              Protocol (SDP) and Real-time Transport Protocol (RTP) for
              Media Loopback", RFC 6849, DOI 10.17487/RFC6849, February
              2013, <http://www.rfc-editor.org/info/rfc6849>.

   [RFC6871] Gilman, R., Even, R., and F. Andreasen, "Session
              Description Protocol (SDP) Media Capabilities
              Negotiation", RFC 6871, DOI 10.17487/RFC6871, February
              2013, <http://www.rfc-editor.org/info/rfc6871>.

   [RFC6947] Boucadair, M., Kaplan, H., Gilman, R., and S.
              Veikkolainen, "The Session Description Protocol (SDP)
              Alternate Connectivity (ALTC) Attribute", RFC 6947, DOI
              10.17487/RFC6947, May 2013,
              <http://www.rfc-editor.org/info/rfc6947>.

   [RFC7006] Garcia-Martin, M., Veikkolainen, S., and R. Gilman,
              "Miscellaneous Capabilities Negotiation in the Session
              Description Protocol (SDP)", RFC 7006, DOI 10.17487/
              RFC7006, September 2013,
              <http://www.rfc-editor.org/info/rfc7006>.

   [RFC7104] Begen, A., Cai, Y., and H. Ou, "Duplication Grouping
              Semantics in the Session Description Protocol", RFC 7104,
              DOI 10.17487/RFC7104, January 2014,
              <http://www.rfc-editor.org/info/rfc7104>.

   [RFC7195] Garcia-Martin, M. and S. Veikkolainen, "Session
              Description Protocol (SDP) Extension for Setting Audio and
              Video Media Streams over Circuit-Switched Bearers in the
              Public Switched Telephone Network (PSTN)", RFC 7195, DOI
              10.17487/RFC7195, May 2014,
              <http://www.rfc-editor.org/info/rfc7195>.

   [RFC7197] Begen, A., Cai, Y., and H. Ou, "Duplication Delay
              Attribute in the Session Description Protocol", RFC 7197,
              DOI 10.17487/RFC7197, April 2014,
              <http://www.rfc-editor.org/info/rfc7197>.

   [RFC7266] Clark, A., Wu, Q., Schott, R., and G. Zorn, "RTP Control
              Protocol (RTCP) Extended Report (XR) Blocks for Mean
              Opinion Score (MOS) Metric Reporting", RFC 7266, DOI
              10.17487/RFC7266, June 2014,
              <http://www.rfc-editor.org/info/rfc7266>.

   [RFC7272] van Brandenburg, R., Stokking, H., van Deventer, O.,
              Boronat, F., Montagud, M., and K. Gross, "Inter-
              Destination Media Synchronization (IDMS) Using the RTP
              Control Protocol (RTCP)", RFC 7272, DOI 10.17487/RFC7272,
              June 2014, <http://www.rfc-editor.org/info/rfc7272>.

   [RFC7273] Williams, A., Gross, K., van Brandenburg, R., and H.
              Stokking, "RTP Clock Source Signalling", RFC 7273, DOI
              10.17487/RFC7273, June 2014,
              <http://www.rfc-editor.org/info/rfc7273>.

   [RFC7657] Black, D., Ed. and P. Jones, "Differentiated Services
              (Diffserv) and Real-Time Communication", RFC 7657, DOI
              10.17487/RFC7657, November 2015,
              <http://www.rfc-editor.org/info/rfc7657>.

   [T.38]   "Procedures for real-time Group 3 facsimile communication
              over IP networks", <http://www.itu.int/rec/T-REC-T.38/e>.

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