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A Framework for Session Description Protocol (SDP) Attributes When Multiplexing

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 a 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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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, [RFC8843] 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) [RFC8445] 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 the 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 and 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 <https://www.3gpp.org> for more information about this organization.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

3. Motivation

An effort to reduce the number of necessary transport-level flows is required because of the time and complications involved in setting up Secure Real-time Transport Protocol (SRTP) [RFC5763] transports for use by RTP based on ICE [RFC8445] and Datagram Transport Layer Security (DTLS). These procedures motivate conservation of ports bindings on the Network Address Translators (NATs). This necessity has resulted in the definition of ways, such as that described in [RFC8843], 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 that 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, media level, or source level. Informally, there are various semantic groupings for these attributes. One such grouping could be as follows:

- * Attributes related to media content such as media type, encoding schemes, and payload types.
- * Attributes specifying media transport characteristics such as RTP/ RTP Control Protocol (RTCP) port numbers, network addresses, and QoS.
- * Metadata description attributes capturing session timing and origin information.
- * 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

It is not advisable to multiplex with the attributes in the CAUTION category, 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 is a connection-oriented protocol and therefore 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=rtppmap:31 H261/90000
a=rtcp-mux
```

Note: Even though IDENTICAL attributes must be repeated across all media descriptions under multiplexing, they might not always be explicitly encoded across all media descriptions. [RFC8843] defines rules for when attributes and their values are implicitly applied to media description.

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, the "a=crypto" attribute is defined for both the audio and 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 the BUNDLE grouping semantic [RFC8843], which mandates that the values from the "m=" line corresponding to the mid appearing first on the "a=group:BUNDLE" line 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=rtppmap: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=rtppmap: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 capabilities in the SDP related to transport, media, and media format.

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=sgn: 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 this 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 the basis of the payload type, and they 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 Section 9.1 of [RFC8843] 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 (for example, rtpmap and fmtp) are identical. (Note: some line breaks 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 example, for the attribute "extmap" [RFC5285], the specification defining the extension needs to be consulted 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:

- * S -- Session level
- * M -- Media level
- * B -- Both (Implies either a session level or a media level attribute)
- * SR -- Source-level (for a single SSRC) [RFC5576]

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

5.1. RFC 4566: 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 MUST be the same for a given codec configuration.	M	IDENTICAL-PER-PT
maxptime	The attribute value MUST be the same for a given codec configuration.	M	IDENTICAL-PER-PT

orient	Not impacted	M	NORMAL
framerate	The attribute value MUST be the same for a given codec configuration.	M	IDENTICAL-PER-PT
quality	Not impacted	M	NORMAL
rtpmap	The attribute value MUST be the same for a given codec configuration.	M	IDENTICAL-PER-PT
fntp	The attribute value MUST be the 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

Table 1: RFC 4566 Attribute Analysis

5.2. RFC 4585: 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 attributes are scoped by payload type (PT), their values MUST be identical for a given PT across the multiplexed "m=" lines.	M	IDENTICAL-PER-PT

Table 2: RFC 4585 Attribute Analysis

5.3. RFC 5761: 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 affects the entire RTP session.	M	IDENTICAL

Table 3: RFC 5761 Attribute Analysis

5.4. RFC 3312: 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

Table 4: RFC 3312 Attribute Analysis

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

5.5. RFC 4574: 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

Table 5: RFC 4574 Attribute Analysis

5.6. RFC 5432: QoS Mechanism Selection in SDP

[RFC5432] defines procedures for negotiating 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

Table 6: RFC 5432 Attribute Analysis

5.7. RFC 4568: SDP Security Descriptions

[RFC4568] defines an 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 that corresponds to the "m=" line chosen for setting up the underlying transport flow.	M	TRANSPORT

Table 7: RFC 4568 Attribute Analysis

5.8. RFC 5762: 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 RFC 6773 is not being used in addition to RFC5762, the port in the "m=" line is a DCCP port. Being a connection-oriented protocol, DCCP does not allow multiple connections on the same 5-tuple.	M	CAUTION

Table 8: RFC 5762 Attribute Analysis

NOTE: If RFC 6773 is being used in addition to RFC 5762, and the DCCP-in-UDP layer has additional demultiplexing, then it may be possible to use different DCCP service codes for each DCCP flow, given each uses a different DCCP port. However, 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. RFC 6773: 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) middleboxes without modification of those middleboxes.

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

Table 9: RFC 6773 Attribute Analysis

NOTE: RFC 6773 allows DCCP-UDP encapsulation, with the UDP port being

the port of the DCCP encapsulation/decapsulation 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. 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. Whether or not this works depends on the nature of DCCP encapsulation and ports choices; it is thus very application dependent.

5.10. RFC 5506: 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 entire RTP session.	M	IDENTICAL

Table 10: RFC 5506 Attribute Analysis

5.11. RFC 6787: 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

Table 11: RFC 6787 Attribute Analysis

5.12. RFC 8445: ICE

[RFC8445] 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	B	TRANSPORT

	setting up the underlying transport flow.		
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
ice2	Not impacted	S	NORMAL

Table 12: RFC 8445 Attribute Analysis

5.13. RFC 5285: RTP Header Extensions

[RFC5285] provides a general mechanism for using the header-extension feature of RTP. (Note: [RFC5285] has been obsoleted by [RFC8285].) 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 decentralized. 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 specific RTP extension.	B	SPECIAL

Table 13: RFC 5285 Attribute Analysis

5.14. RFC 3605: 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 for indicating the RTCP port.

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

Table 14: RFC 3605 Attribute Analysis

5.15. RFC 5576: Source-Specific SDP Attributes

[RFC5576] defines a mechanism for describing RTP media sources -- which are identified by their synchronization source (SSRC) identifiers -- in SDP, to associate attributes with these sources and

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 for specific analysis of the grouping semantics.	M	NORMAL
cname	Not impacted	SR	NORMAL
previous-ssrc	Refer to notes below	SR	NORMAL
fntp	The attribute value MUST be the same for a given codec configuration.	SR	IDENTICAL-PER-PT

Table 15: RFC 5576 Attribute Analysis

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

5.16. RFC 7273: RTP Clock Source Signaling

[RFC7273] specifies SDP signaling that identifies timestamp reference clock sources and SDP signaling 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

Table 16: RFC 7273 Attribute Analysis

5.17. RFC 6236: 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 handheld 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 be the same for a given codec configuration.	M	IDENTICAL-PER-PT

Table 17: RFC 6236 Attribute Analysis

5.18. RFC 7197: 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

Table 18: RFC 7197 Attribute Analysis

5.19. RFC 7266: RTCP XR Blocks for MOS Metric Reporting

[RFC7266] defines an RTCP Extended Report (XR) Block that includes 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

Table 19: RFC 7266 Attribute Analysis

5.20. RFC 6285: Rapid Acquisition of Multicast RTP Sessions

[RFC6285] describes a method of 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

Table 20: RFC 6285 Attribute Analysis

5.21. RFC 6230: 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

Table 21: RFC 6230 Attribute Analysis

5.22. RFC 6364: 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

Table 22: RFC 6364 Attribute Analysis

5.23. RFC 4796: "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

Table 23: RFC 4796 Attribute Analysis

5.24. RFC 3407: 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

Table 24: RFC 3407 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 the actual attribute being encapsulated and the implications of the numerical values assigned. Hence it is recommended to consult the specification defining attributes "cparmin" and "cparmax" to further analyze their behavior under multiplexing.

5.25. RFC 6284: 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 mapping is required by the application	M	CAUTION

Table 25: RFC 6284 Attribute Analysis

5.26. RFC 6714: 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 middleboxes to anchor the MSRP connection without the need for middleboxes to modify the MSRP messages; thus, it also enables secure end-to-end MSRP communication in networks where such middleboxes are deployed. This document also defines an 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

Table 26: RFC 6714 Attribute Analysis

NOTE: As per Section 9 of [RFC8843], there exists no publicly available specification that defines procedures for multiplexing/demultiplexing MSRP flows over a single 5-tuple. Once such a specification is available, the assignments of multiplexing categories for the attributes in this section could be revisited.

5.27. RFC 4583: SDP Format for BFCP Streams

[RFC4583] 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	Refer to notes below	M	TBD
confid	Refer to notes below	M	TBD
userid	Refer to notes below	M	TBD
floorid	Refer to notes below	M	TBD

Table 27: RFC 4583 Attribute Analysis

NOTE: [RFC4583] has been obsoleted by [RFC8856], which redefines the SDP attributes listed in this section, including the "Mux Category" values. However, [RFC8856] does not change the "Mux Category" values of the attributes.

NOTE: As per Section 9 of [RFC8843], there exists no publicly available specification that defines procedures for multiplexing/demultiplexing BFCP streams over a single 5-tuple. Once such a specification is available, the assignments of multiplexing categories for the attributes in this section could be revisited.

5.28. RFC 5547: 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

Table 28: RFC 5547 Attribute Analysis

NOTE: As per Section 9 of [RFC8843], there exists no publicly available specification that defines procedures for multiplexing/demultiplexing MSRP flows over a single 5-tuple. Once such a specification is available, the assignments of multiplexing categories for attributes in this section could be revisited.

5.29. RFC 6849: SDP and RTP Media Loopback Extension

[RFC6849] adds new SDP media types and attributes that 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	M	IDENTICAL-PER-PT

	given codec configuration.		
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

Table 29: RFC 6849 Analysis

5.30. RFC 5760: 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 reported across all multiplexed "m=" lines.	M	IDENTICAL

Table 30: RFC 5760 Attribute Analysis

5.31. RFC 3611: 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

Table 31: RFC 3611 Attribute Analysis

5.32. RFC 5939: 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
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Table 32: RFC 5939 Attribute Analysis

5.33. RFC 6871: SDP Media Capabilities Negotiation

SDP capability negotiation provides a general framework for indicating and negotiating capabilities in SDP. The base framework only defines 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

Table 33: RFC 6871 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. RFC 7006: Miscellaneous Capabilities Negotiation in 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 the "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

Table 34: RFC 7006 Attribute Analysis

5.35. RFC 4567: 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

Table 35: RFC 4567 Attribute Analysis

5.36. RFC 4572: 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. (Note: [RFC4572] has been obsoleted by [RFC8122].) 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 MUST be the one that corresponds to the "m=" line chosen for setting up the underlying transport flow.	B	TRANSPORT

Table 36: RFC 4572 Attribute Analysis

5.37. RFC 4570: 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 repeated across all multiplexed "m=" lines.	B	IDENTICAL

Table 37: RFC 4570 Attribute Analysis

5.38. RFC 6128: 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

Table 38: RFC 6128 Attribute Analysis

5.39. RFC 6189: 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	The zrtp-hash attribute MUST be the one that corresponds to the "m=" line chosen for setting up the underlying transport flow.	M	TRANSPORT

Table 39: RFC 6189 Attribute Analysis

5.40. RFC 4145: 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 re-establishment.

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

Table 40: RFC 4145 Attribute Analysis

5.41. RFC 6947: 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 "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 ones that correspond to the "m=" line chosen for setting up the underlying transport flow.	M	TRANSPORT

Table 41: RFC 6947 Attribute Analysis

5.42. RFC 7195: SDP Extension for Circuit-Switched Bearers in PSTN

[RFC7195] describes use cases, requirements, and protocol extensions for using the 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 below	M	TBD
cs-correlation:uui	Refer to notes below	M	TBD
cs-correlation:dtmf	Refer to notes below	M	TBD
cs-correlation:external	Refer to notes below	M	TBD

Table 42: RFC 7195 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 [RFC8843] requires the "c=" line nettype value to be "IN". If there exists in future 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. RFC 7272: 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

Table 43: RFC 7272 Attribute Analysis

5.44. RFC 5159: Open Mobile Alliance (OMA) Broadcast (BCAST) SDP Attributes

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

Name	Notes	Level	Mux Category
bcastversion	Not impacted	S	NORMAL
stkmstream	Not impacted	B	NORMAL
SRTPAuthentication	Needs further analysis	M	TBD
SRTPROCTxRate	Needs further analysis	M	TBD

Table 44: RFC 5159 Attribute Analysis

5.45. RFC 6193: 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 context of multiplexing	B	CAUTION
psk-fingerprint	Unlikely to use IKE in the context of multiplexing	B	CAUTION
ike-esp	Unlikely to use IKE in the context of multiplexing	B	CAUTION
ike-esp-udpencap	Unlikely to use IKE in the context of multiplexing	B	CAUTION

Table 45: RFC 6193 Attribute Analysis

5.46. RFC 2326: 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	RFC 2326 is obsolete.	B	CAUTION
range	RFC 2326 is obsolete.	B	CAUTION
control	RFC 2326 is obsolete.	B	CAUTION
mtag	RFC 2326 is obsolete.	B	CAUTION

Table 46: RFC 2326 Attribute Analysis

NOTE: [RFC2326] defines SDP attributes that are applicable in the declarative usage of SDP alone. For the purposes of this document, only the offer/answer usage of SDP is considered to be mandated by [RFC8843].

5.47. RFC 7826: 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
range	RTSP is not supported for RTP stream multiplexing.	B	CAUTION
control	RTSP is not supported for RTP stream multiplexing.	B	CAUTION
mtag	RTSP is not supported for RTP stream multiplexing.	B	CAUTION

Table 47: RFC 7826 Attribute Analysis

NOTE: [RFC7826] defines SDP attributes that are applicable in the declarative usage of SDP alone. For the purposes of this document, only the offer/answer usage of SDP is considered to be mandated by [RFC8843].

5.48. RFC 6064: 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	M	CAUTION

	notes below		
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 notes below	M	CAUTION

Table 48: RFC 6064 Attribute Analysis

NOTE: [RFC6064] defines SDP attributes that are applicable in the declarative usage of SDP alone. For the purposes of this document, only the offer/answer usage of SDP is considered to be mandated by [RFC8843].

5.49. RFC 3108: 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	B	CAUTION

	notes below		
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
anycast	Refer to notes below	B	CAUTION
cache	Refer to notes below	B	CAUTION
bearerSigIE	Refer to notes below	B	CAUTION
aalApp	Refer to notes below	B	CAUTION
cbrRate	Refer to notes below	B	CAUTION
sbc	Refer to notes below	B	CAUTION
clkrec	Refer to notes below	B	CAUTION
fec	Refer to notes below	B	CAUTION
prtfl	Refer to notes below	B	CAUTION
structure	Refer to notes below	B	CAUTION
cpsSDUsize	Refer to notes below	B	CAUTION

aal2CPS	Refer to notes below	B	CAUTION
aal2CPSSDURate	Refer to notes below	B	CAUTION
aal2sscs3661unassured	Refer to notes below	B	CAUTION
aal2sscs3661assured	Refer to notes below	B	CAUTION
aal2sscs3662	Refer to notes below	B	CAUTION
aal5sscscop	Refer to notes below	B	CAUTION
atmmmap	Refer to notes below	B	CAUTION
silenceSupp	Refer to notes below	B	CAUTION
ecan	Refer to notes below	B	CAUTION
gc	Refer to notes below	B	CAUTION
profileDesc	Refer to notes below	B	CAUTION
vsel	Refer to notes below	B	CAUTION
dsel	Refer to notes below	B	CAUTION
fsel	Refer to notes below	B	CAUTION
onewaySel	Refer to notes below	B	CAUTION
codeccconfig	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

Table 49: RFC 3108 Attribute Analysis

NOTE: RFC 3108 describes conventions for using SDP for characterizing ATM bearer connections using an AAL1, AAL2, or AAL5 adaptation layer. 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 RFC 3108, a real-time media stream (voice, video, voiceband data, pseudowire, and others) or a multiplex of media streams is mapped directly into an ATM connection. RFC 3108 does not address cases where ATM serves as a low-level transport pipe for IP packets that

can, in turn, carry one or more real-time (e.g., VoIP) media sessions with a life cycle different from that of the underlying ATM transport.

5.50. 3GPP TS 183.063

[TISPAN] describes 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

Table 50: 3GPP TS 183.063 Attribute Analysis

5.51. 3GPP TS 24.229

[IP-CALL] specifies an 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

Table 51: 3GPP TS 24.229 Attribute Analysis

5.52. 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

Table 52: ITU T.38 Attribute Analysis

NOTE: As per Section 9 of [RFC8843], there exists no publicly available specification that defines procedures for multiplexing/demultiplexing fax protocol 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.

5.53. 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 the types of IP bearer control protocol (IPBCP) message used in BICC (ITU-T Q.1901) environment that are limited to single-media payload. Refer to the pertinent ITU-T specifications while multiplexing.	S	SPECIAL

Table 53: ITU-T Q.1970 Attribute Analysis

5.54. ITU-T H.248.15

ITU-T H.248.15 [H.248.15] defines the 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 package 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

Table 54: ITU-T H.248.15 Attribute Analysis

5.55. RFC 4975: The Message Session Relay Protocol

[RFC4975] describes 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 below	M	TBD
accept-wrapped-types	Refer to notes below	M	TBD
max-size	Refer to notes below	M	TBD
path	Refer to notes below	M	TBD

Table 55: RFC 4975 Attribute Analysis

NOTE: As per Section 9 of [RFC8843], there exists no publicly available specification that defines procedures for multiplexing/demultiplexing MSRP 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.

5.56. 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
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Table 56: Historical Attribute Analysis

6. bwtype Attribute Analysis

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

6.1. RFC 4566: 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 media-level usage, the aggregate of individual bandwidth values is considered.	B	SUM

Table 57: RFC 4566 bwtype Analysis

6.2. RFC 3556: 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 an RTP session.

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

Table 58: RFC 3556 bwtype Analysis

6.3. RFC 3890: 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 bitrate value together with the maximum packet rate can then be used to calculate the real bitrate over the transport actually used.

Name	Notes	Level	Mux Category
bwtype:TIAS	The usage of TIAS is not defined under offer/answer usage.	B	SPECIAL

maxprate	The usage of TIAS and maxprate is not well defined under multiplexing.	B	SPECIAL
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Table 59: RFC 3890 bwtype Analysis

NOTE: The intention of TIAS is that the media-level bitrate is multiplied with the known per-packet overhead for the selected transport and the maxprate value to determine the worst-case bitrate 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. RFC 4585: RTP/AVPF

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

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

Table 60: RFC 4585 Attribute Analysis

7.2. RFC 5104: 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 the same for a given codec configuration.	M	IDENTICAL-PER-PT

Table 61: RFC 5104 Attribute Analysis

7.3. RFC 6285: Unicast-Based Rapid Acquisition of Multicast RTP Sessions (RAMS)

[RFC6285] describes a method of 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 rai	The attribute value MUST be the same for a given codec configuration.	M	IDENTICAL-PER-PT

Table 62: RFC 6285 Attribute Analysis

7.4. RFC 6679: 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 is enabled at the RTP session level.	M	IDENTICAL
nack ecn	This attribute enables ECN at the RTP session level.	M	IDENTICAL

Table 63: RFC 6679 Attribute Analysis

7.5. RFC 6642: 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] 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 tllei	The attribute value MUST be the same for a given codec configuration.	M	IDENTICAL-PER-PT
nack pslei	The attribute value MUST be the same for a given codec configuration.	M	IDENTICAL-PER-PT

Table 64: RFC 6642 Attribute Analysis

7.6. RFC 5104: 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 fir	The attribute value MUST be the same for a given codec configuration.	M	IDENTICAL-PER-PT
ccm tmbr	The attribute value MUST be the same for a given codec configuration.	M	IDENTICAL-PER-PT
ccm tstr	The attribute value MUST be the same for a given codec configuration.	M	IDENTICAL-PER-PT
ccm vbcn	The attribute value MUST be the same for a given codec configuration.	M	IDENTICAL-PER-PT

Table 65: RFC 5104 Attribute Analysis

8. group Attribute Analysis

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

8.1. RFC 5888: 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

Table 66: RFC 5888 Attribute Analysis

8.2. RFC 3524: 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

Table 67: RFC 3524 Attribute Analysis

8.3. RFC 4091: ANAT Semantics

[RFC4091] defines ANAT semantics for the SDP grouping framework. (Note: [RFC4091] has been obsoleted by [RFC8445].) 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

Table 68: RFC 4091 Attribute Analysis

8.4. RFC 5956: FEC Grouping Semantics in SDP

[RFC5956] defines the semantics for grouping the associated source and FEC-based 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; they also provide support for additive repair flows. SSRC-level 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

Table 69: RFC 5956 Attribute Analysis

8.5. RFC 5583: 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 using 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 be the same for a given codec configuration.	M	IDENTICAL-PER-PT
depend mdc	The attribute value MUST be the same for a given codec configuration.	M	IDENTICAL-PER-PT

Table 70: RFC 5583 Attribute Analysis

8.6. RFC 7104: 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
group:DUP	Not impacted	S	NORMAL

Table 71: RFC 7104 Attribute Analysis

9. ssrc-group Attribute Analysis

This section analyzes "ssrc-group" semantics.

9.1. RFC 5576: Source-Specific SDP Attributes

[RFC5576] defines a mechanism for describing RTP media sources -- which are identified by their synchronization source (SSRC) identifiers -- in SDP, to associate attributes with these sources and 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

Table 72: RFC 5576 Attribute Analysis

9.2. RFC 7104: 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

Table 73: RFC 7104 Attribute Analysis

10. QoS Mechanism Token Analysis

This section analyzes QoS tokens specified with SDP.

10.1. RFC 5432: 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 corresponds to the "m=" line chosen for setting up the underlying transport flow.	B	TRANSPORT
nsis	rsvp attribute MUST be the one	B	TRANSPORT

	that corresponds to the "m=" line chosen for setting up the underlying transport.		
--	---	--	--

Table 74: RFC 5432 Attribute Analysis

NOTE: A single Differentiated Services Code Point (DSCP) for each 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. RFC 4566: 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 attribute under multiplexing.	S	CAUTION

Table 75: RFC 4566 Attribute Analysis

12. content Attribute Analysis

12.1. RFC 4796

[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

Table 76: RFC 4796 Attribute Analysis

12.2. 3GPP TS 24.182

[IMS-CAT] specifies an IP multimedia subsystem for customized alerting tones.

Name	Notes	Level	Mux Category
g.3gpp.cat	Usage defined for the IP multimedia subsystem	M	NORMAL

Table 77: 3GPP TS 24.182 Attribute Analysis

12.3. 3GPP TS 24.183

[IMS-CRS] specifies an IP multimedia subsystem for customized ringing signal.

Name	Notes	Level	Mux Category
g.3gpp.crs	Usage defined for the IP multimedia subsystem	M	NORMAL

Table 78: 3GPP TS 24.183 Attribute Analysis

13. Payload Formats

13.1. RFC 5109: 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

Table 79: RFC 5109 Payload Format Analysis

14. Multiplexing Considerations for Encapsulating Attributes

This section deals with recommendations for defining the multiplexing characteristics of the SDP attributes that encapsulate other SDP attributes/parameters. As of today, such attributes, 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. RFC 3407: cpar Attribute Analysis

The [RFC3407] capability parameter attribute "a=cpar" encapsulates a "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=sgn: 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 this example, the category IDENTICAL is inherited for the cpar-encapsulated "rtcp-mux" attribute.

14.2. RFC 5939 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:

- * 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.
- * 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.
- * 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.
- * 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 the answerer's procedure for choosing 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 choose valid combinations of potential configurations across media descriptions in a given BUNDLE group, we provide a simple rule for constructing potential configurations:

- * Let m-bundle be the set of media descriptions that form a given bundle.
- * Let m-bundle-pcfg be the set of media descriptions in m-bundle that include one or more potential configurations.
- * Each media description in m-bundle-pcfg MUST have at least one potential configuration with the same configuration number (e.g., "1").
- * 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.
- * Since it is nearly impossible to define a generic mechanism for various capability extensions, this document doesn't provide procedures for dealing with the capability-extension attributes. However, Section 14.3 provides 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 chooses 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 this example, the potential configurations that offer transport-protocol capability of RTP/SAVPF have 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:EcGZiNWpFJhQXdspcllekcmVCNWPVLcfHAWJSoj|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 this example, 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. RFC 6871 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 parameter ("`pt`") 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, described in [RFC8843], 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`" and "`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 this example, 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 media capabilities 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 configuration that provides configuration information that may be used to guide a subsequent offer/exchange -- e.g., by adding another media stream or using alternative codec combinations not currently offered. Latent configurations have configuration numbers that 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

Section 15.1 defines a new subregistry, which has been added by the IANA, for identifying the initial registrations for various multiplexing categories applicable, as described in this document.

IANA has added 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 the names of entries in the existing subregistry and specify the value to be put in the new "Mux Category" column of the associated IANA registry for each.

15.1. New "Multiplexing Categories" Subregistry

A new subregistry has been created. It is called "Multiplexing Categories" and has the following registrations initially:

Multiplexing Categories	Reference
NORMAL	RFC 8859
CAUTION	RFC 8859
IDENTICAL	RFC 8859
TRANSPORT	RFC 8859
SUM	RFC 8859

INHERIT	RFC 8859
IDENTICAL-PER-PT	RFC 8859
SPECIAL	RFC 8859
TBD	RFC 8859

Table 80

Further entries can be registered using Standard Actions policies outlined in [RFC8126], 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 in the "Session Description Protocol (SDP) Parameters" registry.

15.2. "Mux Category" Column for Subregistries

Each subsection identifies a subregistry of 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.

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

The registration policy for updates to the "Mux Category" column values for existing parameters, or when registering new parameters, is beyond the scope of this document. The registration policy for the affected table is defined in [RFC8866].

15.2.1. Table: SDP bwttype

The following values have been added to the "bwttype" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to this RFC as well as the previous references.

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

Table 81

15.2.2. Table: attribute-name

The following values have been added to the "attribute-name" (formerly "att-field") subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to this RFC as well as the previous references.

NOTE: The attributes from [FLUTE] ("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 the purposes of this specification, the multiplexing category of "TBD" is assigned.

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
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
etag	CAUTION
duplication-delay	NORMAL
range	CAUTION
control	CAUTION
mtag	CAUTION
ts-refclk	NORMAL
mediaclk	NORMAL
calgextmap	NORMAL
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
fntp	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
aal2CPS	CAUTION
aal2CPSSDUrate	CAUTION

aal2sscs3661unassured	CAUTION
aal2sscs3661assured	CAUTION
aal2sscs3662	CAUTION
aal5sscscop	CAUTION
atmmap	CAUTION
silenceSupp	CAUTION
ecan	CAUTION
gc	CAUTION
profileDesc	CAUTION
vsel	CAUTION
dsel	CAUTION
fsel	CAUTION
onewaySel	CAUTION
codeccconfig	CAUTION
isup_usi	CAUTION
uiLayer1_Prot	CAUTION
chain	CAUTION
floorctrl	TBD
confid	TBD
userid	TBD
floorid	TBD
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-initpredecbufferperiod	CAUTION
X-initpostdecbufferperiod	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
cw-id	NORMAL
portmapping-req	CAUTION
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
cname	NORMAL
previous-ssrc	NORMAL
fntp	IDENTICAL-PER-PT
ts-refclk	NORMAL
mediaclock	NORMAL

Table 82

15.2.3. Table: content SDP Parameters

The following values have been added to the "content SDP Parameters" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to this RFC as well as the previous references.

SDP Name	Mux Category
slides	NORMAL
speaker	NORMAL

sl	NORMAL
main	NORMAL
alt	NORMAL
g.3gpp.cat	NORMAL
g.3gpp.crs	NORMAL

Table 83

15.2.4. Table: Semantics for the "group" SDP Attribute

The following values have been added to the "Semantics for the 'group' SDP Attribute" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to 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

Table 84

15.2.5. Table: "rtcp-fb" Attribute Values

The following values have been added to the "'rtcp-fb' Attribute Values" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to 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

Table 85

15.2.6. Table: "ack" and "nack" Attribute Values

The following values have been added to the "'ack' and 'nack'"

Attribute Values" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to 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

Table 86

15.2.7. Table: "depend" SDP Attribute Values

The following values have been added to the "'depend' SDP Attribute Values" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to this RFC as well as the previous references.

Token	Mux Category
lay	IDENTICAL-PER-PT
mdc	IDENTICAL-PER-PT

Table 87

15.2.8. Table: "cs-correlation" Attribute Values

The following values have been added to the "'cs-correlation' Attribute Values" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to this RFC as well as the previous references.

Value	Mux Category
callerid	TBD
uuie	TBD
dtmf	TBD
external	TBD

Table 88

15.2.9. Table: Semantics for the "ssrc-group" SDP Attribute

The following values have been added to the "Semantics for the 'ssrc-group' SDP Attribute" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to this RFC as well as the previous references.

Token	Mux Category
FID	NORMAL
FEC	NORMAL
FEC-FR	NORMAL
DUP	NORMAL

Table 89

15.2.10. Table: SDP/RTSP Key Management Protocol Identifiers

The following values have been added to the "SDP/RTSP key management protocol identifiers" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to this RFC as well as the previous references.

Value Name	Mux Category
mikey	IDENTICAL

Table 90

15.2.11. Table: Codec Control Messages

The following values have been added to the "Codec Control Messages" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to 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

Table 91

15.2.12. Table: QoS Mechanism Tokens

The following values have been added to the "QoS Mechanism Tokens" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to this RFC as well as the previous references.

QoS Mechanism	Mux Category
rsvp	TRANSPORT
nsis	TRANSPORT

Table 92

15.2.13. Table: SDP Capability Negotiation Option Tags

The following values have been added to the "SDP Capability Negotiation Option Tags" subregistry of the "Session Description

Protocol (SDP) Parameters" registry. The references have been updated to point to 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

Table 93

15.2.14. Table: Timestamp Reference Clock Source Parameters

The following values have been added to the "Timestamp Reference Clock Source Parameters" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to 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

Table 94

15.2.15. Table: Media Clock Source Parameters

The following values have been added to the "Media Clock Source Parameters" subregistry of the "Session Description Protocol (SDP) Parameters" registry. The references have been updated to point to this RFC as well as the previous references.

Name	Mux Category
sender	NORMAL
direct	NORMAL
IEEE1722	NORMAL

Table 95

16. Security Considerations

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

When multiplexing SDP attributes with the category "CAUTION", the

implementations should be aware of possible issues described in this specification.

17. References

17.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/info/rfc2119>>.
- [RFC4566] Handley, M., Jacobson, V., and C. Perkins, "SDP: Session Description Protocol", RFC 4566, DOI 10.17487/RFC4566, July 2006, <<https://www.rfc-editor.org/info/rfc4566>>.
- [RFC8126] Cotton, M., Leiba, B., and T. Narten, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 8126, DOI 10.17487/RFC8126, June 2017, <<https://www.rfc-editor.org/info/rfc8126>>.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.
- [RFC8843] Holmberg, C., Alvestrand, H., and C. Jennings, "Negotiating Media Multiplexing Using the Session Description Protocol (SDP)", RFC 8843, DOI 10.17487/RFC8843, January 2021, <<https://www.rfc-editor.org/info/rfc8843>>.

17.2. Informative References

- [FLUTE] Walsh, R., Peltotalo, J., Peltotalo, S., Curcio, I. D., and H. Mehta, "SDP Descriptors for FLUTE", Work in Progress, Internet-Draft, draft-ietf-rmt-flute-sdp-03, 12 September 2012, <<https://tools.ietf.org/html/draft-ietf-rmt-flute-sdp-03>>.
- [H.248.15] ITU-T, "Gateway control protocol: SDP ITU-T H.248 package attribute", ITU-T Recommendation H.248.15, March 2013, <<https://www.itu.int/rec/T-REC-H.248.15>>.
- [IANA] IANA, "Session Description Protocol (SDP) Parameters", <<https://www.iana.org/assignments/sdp-parameters>>.
- [IMS-CAT] 3GPP, "IP Multimedia Subsystem (IMS) Customized Alerting Tones (CAT); Protocol specification", Specification 24.182, Specification 24.182, January 2015, <<https://www.3gpp.org/ftp/Specs/html-info/24182.htm>>.
- [IMS-CRS] 3GPP, "IP Multimedia Subsystem (IMS) Customized Ringing Signal (CRS); Protocol specification", Specification 24.183, September 2016, <<https://www.3gpp.org/ftp/Specs/html-info/24183.htm>>.
- [IP-CALL] 3GPP, "IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3", Specification 24.229, September 2016, <<https://www.3gpp.org/ftp/Specs/html-info/24229.htm>>.
- [Q.1970] ITU-T, "Q.1970: BICC IP bearer control protocol", ITU-T Recommendation Q.1970, September 2006, <<https://www.itu.int/rec/T-REC-Q.1970-200609-I/en>>.
- [RFC2326] Schulzrinne, H., Rao, A., and R. Lanphier, "Real Time Streaming Protocol (RTSP)", RFC 2326, DOI 10.17487/RFC2326, April 1998, <<https://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, <<https://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, <<https://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, <<https://www.rfc-editor.org/info/rfc3312>>.
- [RFC3407] Andreasen, F., "Session Description Protocol (SDP) Simple Capability Declaration", RFC 3407, DOI 10.17487/RFC3407, October 2002, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://www.rfc-editor.org/info/rfc4567>>.

- [RFC4568] Andreassen, F., Baugher, M., and D. Wing, "Session Description Protocol (SDP) Security Descriptions for Media Streams", RFC 4568, DOI 10.17487/RFC4568, July 2006, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://www.rfc-editor.org/info/rfc5159>>.
- [RFC5285] Singer, D. and H. Desineni, "A General Mechanism for RTP Header Extensions", RFC 5285, DOI 10.17487/RFC5285, July 2008, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://www.rfc-editor.org/info/rfc5888>>.
- [RFC5939] Andreasen, F., "Session Description Protocol (SDP) Capability Negotiation", RFC 5939, DOI 10.17487/RFC5939, September 2010, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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,

<<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://www.rfc-editor.org/info/rfc6849>>.
- [RFC6871] Gilman, R., Even, R., and F. Andreassen, "Session Description Protocol (SDP) Media Capabilities Negotiation", RFC 6871, DOI 10.17487/RFC6871, February 2013, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://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, <<https://www.rfc-editor.org/info/rfc7657>>.
- [RFC7826] Schulzrinne, H., Rao, A., Lanphier, R., Westerlund, M., and M. Stiemerling, Ed., "Real-Time Streaming Protocol Version 2.0", RFC 7826, DOI 10.17487/RFC7826, December 2016, <<https://www.rfc-editor.org/info/rfc7826>>.
- [RFC8122] Lennox, J. and C. Holmberg, "Connection-Oriented Media Transport over the Transport Layer Security (TLS) Protocol in the Session Description Protocol (SDP)", RFC 8122, DOI 10.17487/RFC8122, March 2017, <<https://www.rfc-editor.org/info/rfc8122>>.
- [RFC8285] Singer, D., Desineni, H., and R. Even, Ed., "A General Mechanism for RTP Header Extensions", RFC 8285, DOI 10.17487/RFC8285, October 2017, <<https://www.rfc-editor.org/info/rfc8285>>.
- [RFC8445] Keranen, A., Holmberg, C., and J. Rosenberg, "Interactive Connectivity Establishment (ICE): A Protocol for Network Address Translator (NAT) Traversal", RFC 8445, DOI 10.17487/RFC8445, July 2018, <<https://www.rfc-editor.org/info/rfc8445>>.
- [RFC8856] Camarillo, G., Kristensen, T., and C. Holmberg, "Session Description Protocol (SDP) Format for Binary Floor Control Protocol (BFCP) Streams", RFC 8856, DOI 10.17487/RFC8856, January 2021, <<https://www.rfc-editor.org/info/rfc8856>>.

- [RFC8866] Begen, A., Kyzivat, P., Perkins, C., and M. Handley, "SDP: Session Description Protocol", RFC 8866, DOI 10.17487/RFC8866, January 2021, <<https://www.rfc-editor.org/info/rfc8866>>.
- [T.38] ITU-T, "Procedures for real-time Group 3 facsimile communication over IP networks", ITU-T Recommendation T.38, November 2015, <<https://www.itu.int/rec/T-REC-T.38/e>>.
- [TISPAN] ETSI, "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS-based IPTV stage 3 specification", Technical Specification 183 063 V2.1.0, June 2008, <https://www.etsi.org/deliver/etsi_ts/183000_183099/183063/02.01.00_60/ts_183063v020100p.pdf>.

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