

**A Framework for SDP Attributes when Multiplexing
draft-ietf-mmusic-sdp-mux-attributes-13**

Abstract

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

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

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Table of Contents

1.	Introduction	5
2.	Terminology	5
3.	Motivation	6
4.	SDP Attribute Analysis Framework	6
4.1.	Category: NORMAL	7
4.2.	Category: CAUTION	7
4.3.	Category: IDENTICAL	8
4.4.	Category: SUM	8
4.5.	Category: TRANSPORT	9
4.6.	Category: INHERIT	10
4.7.	Category: IDENTICAL-PER-PT	10
4.8.	Category: SPECIAL	11
4.9.	Category: TBD	11
5.	Analysis of Existing Attributes	12
5.1.	RFC4566: SDP	12
5.2.	RFC4585: RTP/AVPF	14
5.3.	RFC5761: Multiplexing RTP and RTCP	14
5.4.	RFC3312: Integration of Resource Management and SIP	14
5.5.	RFC4574: SDP Label Attribute	15
5.6.	RFC5432: QOS Mechanism Selection in SDP	15
5.7.	RFC4568: SDP Security Descriptions	16
5.8.	RFC5762: RTP over DCCP	16
5.9.	RFC6773: DCCP-UDP Encapsulation	17
5.10.	RFC5506: Reduced-Size RTCP in RTP Profile	18
5.11.	RFC6787: Media Resource Control Protocol Version 2	18
5.12.	RFC5245: ICE	19
5.13.	RFC5285: RTP Header Extensions	20
5.14.	RFC3605: RTCP attribute in SDP	21
5.15.	RFC5576: Source-Specific SDP Attributes	21
5.16.	RFC7273: RTP Clock Source Signalling	22
5.17.	RFC6236: Image Attributes in SDP	23
5.18.	RFC7197: Duplication Delay Attribute in SDP	24
5.19.	RFC7266: RTCP XR Blocks for MOS Metric Reporting	24
5.20.	RFC6285: Rapid Acquisition of Multicast RTP Sessions	24
5.21.	RFC6230: Media Control Channel Framework	25
5.22.	RFC6364: SDP Elements for FEC Framework	25
5.23.	RFC4796: Content Attribute	26
5.24.	RFC3407: SDP Simple Capability Declaration	26
5.25.	RFC6284: Port Mapping between Unicast and Multicast RTP Sessions	27
5.26.	RFC6714: MSRP-CEMA	28
5.27.	RFC4583: SDP Format for BFCP Streams	28

5.28.	RFC5547	: SDP Offer/Answer for File Transfer	29
5.29.	RFC6849	: SDP and RTP Media Loopback Extension	30
5.30.	RFC5760	: RTCP with Unicast Feedback	30
5.31.	RFC3611	: RTCP XR	31
5.32.	RFC5939	: SDP Capability Negotiation	31
5.33.	RFC6871	: SDP Media Capabilities Negotiation	32
5.34.	RFC7006	: Miscellaneous Capabilities Negotiation SDP . . .	33
5.35.	RFC4567	: Key Management Extensions for SDP and RTSP . . .	34
5.36.	RFC4572	: Comedia over TLS in SDP	35
5.37.	RFC4570	: SDP Source Filters	35
5.38.	RFC6128	: RTCP Port for Multicast Sessions	36
5.39.	RFC6189	: ZRTP	36
5.40.	RFC4145	: Connection-Oriented Media	37
5.41.	RFC6947	: The SDP altc Attribute	37
5.42.	RFC7195	: SDP Extension for Circuit Switched Bearers in PSTN	38
5.43.	RFC7272	: IDMS Using the RTP Control Protocol (RTCP) . . .	38
5.44.	RFC5159	: Open Mobile Alliance (OMA) Broadcast (BCAST) SDP Attributes	39
5.45.	RFC6193	: Media Description for IKE in SDP	39
5.46.	RFC2326	: Real Time Streaming Protocol	40
5.47.	RFC6064	: SDP and RTSP Extensions for 3GPP	41
5.48.	RFC3108	: ATM SDP	43
5.49.	3GPP TS 26.114	. . . . .	45
5.50.	3GPP TS 183.063	. . . . .	46
5.51.	3GPP TS 24.182	. . . . .	46
5.52.	3GPP TS 24.183	. . . . .	47
5.53.	3GPP TS 24.229	. . . . .	47
5.54.	ITU T.38	. . . . .	48
5.55.	ITU-T Q.1970	. . . . .	50
5.56.	ITU-T H.248.15	. . . . .	50
5.57.	RFC4975	: The Message Session Relay Protocol	51
5.58.	Historical Attributes	. . . . .	52
6.	bwtype Attribute Analysis	. . . . .	52
6.1.	RFC4566	: SDP	53
6.2.	RFC3556	: SDP Bandwidth Modifiers for RTCP Bandwidth . . .	53
6.3.	RFC3890	: Bandwidth Modifier for SDP	54
7.	rtcp-fb Attribute Analysis	. . . . .	54
7.1.	RFC4585	: RTP/AVPF	54
7.2.	RFC5104	: Codec Control Messages in AVPF	55
7.3.	RFC6285	: Unicast-Based Rapid Acquisition of Multicast RTP Sessions (RAMS)	56
7.4.	RFC6679	: ECN for RTP over UDP/IP	56
7.5.	RFC6642	: Third-Party Loss Report	57
7.6.	RFC5104	: Codec Control Messages in AVPF	58
8.	group Attribute Analysis	. . . . .	58
8.1.	RFC5888	: SDP Grouping Framework	58
8.2.	RFC3524	: Mapping Media Streams to Resource	

Reservation Flows	59
8.3. RFC4091 : ANAT Semantics	59
8.4. RFC5956 : FEC Grouping Semantics in SDP	59
8.5. RFC5583 : Signaling Media Decoding Dependency in SDP	60
8.6. RFC7104 : Duplication Grouping Semantics in the SDP	60
9. ssrc-group Attribute Analysis	61
9.1. RFC5576 : Source-Specific SDP Attributes	61
9.2. RFC7104 : Duplication Grouping Semantics in the SDP	61
10. QoS Mechanism Token Analysis	62
10.1. RFC5432 : QoS Mechanism Selection in SDP	62
11. k= Attribute Analysis	62
11.1. RFC4566 : SDP	63
12. content Attribute Analysis	63
12.1. RFC4796	63
13. Payload Formats	64
13.1. RFC5109 : RTP Payload Format for Generic FEC	64
14. Multiplexing Considerations for Encapsulating Attributes	64
14.1. RFC3407 : cpar Attribute Analysis	65
14.2. RFC5939 Analysis	65
14.2.1. Recommendation: Procedures for Potential Configuration Pairing	66
14.2.1.1. Example: Transport Capability Multiplexing	67
14.2.1.2. Example: Attribute Capability Multiplexing	68
14.3. RFC6871 Analysis	69
14.3.1. Recommendation: Dealing with Payload Type Numbers	69
14.3.1.1. Example: Attribute Capability Under Shared Payload Type	69
14.3.2. Recommendation: Dealing with Latent Configurations	70
15. IANA Considerations	71
15.1. New 'Multiplexing Categories' subregistry	71
15.2. 'Mux Category' column for subregistries	72
15.2.1. Table: SDP bwtype	72
15.2.2. Table: att-field (session level)	72
15.2.3. Table: att-field (both session and media level)	73
15.2.4. Table: att-field (media level only)	75
15.2.5. Table: att-field (source level)	78
15.2.6. Table: content SDP Parameters	79
15.2.7. Table: Semantics for the 'group' SDP Attribute	79
15.2.8. Table: 'rtcp-fb' Attribute Values	79
15.2.9. Table: 'ack' and 'nack' Attribute Values	80
15.2.10. Table: 'depend' SDP Attribute Values	80
15.2.11. Table: 'cs-correlation' Attribute Values	81
15.2.12. Table: Semantics for the 'ssrc-group' SDP Attribute	81
15.2.13. Table: SDP/RTSP key management protocol identifiers	81
15.2.14. Table: Codec Control Messages	82
15.2.15. Table: QoS Mechanism Tokens	82
15.2.16. Table: SDP Capability Negotiation Option Tags	82
15.2.17. Table: Timestamp Reference Clock Source Parameters	83

15.2.18 . Table: Media Clock Source Parameters	83
16 . Security Considerations	83
17 . Acknowledgments	84
18 . Change Log	84
19 . References	87
19.1 . Normative References	87
19.2 . Informative References	87
Author's Address	95

[1](#). Introduction

SDP defines several attributes for capturing characteristics that apply to the individual media descriptions (described by "m=" lines) and the overall multimedia session. Typically different media types (audio, video, etc.) described using different media descriptions represent separate RTP sessions that are carried over individual transport layer flows. However

[[I-D.ietf-mmusic-sdp-bundle-negotiation](#)] defines a way to use a single address:port combination (BUNDLE address) for receiving media associated with multiple SDP media descriptions. This would, for example allow the usage of a single set of Interactive Connectivity Establishment (ICE) [[RFC5245](#)] candidates for multiple media descriptions. This in turn has made it necessary to understand the interpretation and usage of the SDP attributes defined for the multiplexed media descriptions.

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

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

[2](#). Terminology

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

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

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [[RFC2119](#)].

3. Motivation

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

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

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

4. SDP Attribute Analysis Framework

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

- o Attributes related to media content such as media type, encoding schemes and payload types.
- o Attributes specifying media transport characteristics like RTP/RTCP Control Protocol (RTCP) port numbers, network addresses and QoS.
- o Metadata description attributes capturing session timing and origin information.
- o Attributes establishing relationships between media descriptions such as grouping framework [[RFC5888](#)]

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

4.1. Category: NORMAL

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

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

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

4.2. Category: CAUTION

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

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


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

4.3. Category: IDENTICAL

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

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

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

4.4. Category: SUM

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

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

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

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

4.5. Category: TRANSPORT

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

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

```
v=0
o=alice 2890844526 2890844527 IN IP4 host.atlanta.example.com
s=
c=IN IP4 host.atlanta.example.com
t=0 0
a=group:BUNDLE bar foo
m=audio 49172 RTP/AVP 99
a=mid:foo
a=crypto:1 AES_CM_128_HMAC_SHA1_80
  inline:d0RmdmcmVCspeEc3QGZiNWpVLFJhQX1cfHAWJSoj|2^20|1:32
a=rtpmap:99 iLBC/8000
m=video 51374 RTP/AVP 31
a=mid:bar
a=crypto:1 AES_CM_128_HMAC_SHA1_80
  inline:EcGZiNWpFJhQXdspcl1ekcmVCNWpVLcfHAWJSoj|2^20|1:32
a=rtpmap:96 H261/90000
```


4.6. Category: INHERIT

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

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

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

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

4.7. Category: IDENTICAL-PER-PT

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

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

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

4.9. Category: TBD

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

5. Analysis of Existing Attributes

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

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

- o S -- Session level
- o M -- Media level
- o B -- Both
- o SR -- Source-level (for a single SSRC) [[RFC5576](#)]

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

5.1. [RFC4566](#): SDP

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

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

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

5.1 [RFC4566](#) Attribute Analysis

5.2. [RFC4585](#): RTP/AVPF

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

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

5.2 [RFC4585](#) Attribute Analysis

5.3. [RFC5761](#): Multiplexing RTP and RTCP

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

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

5.3 [RFC5761](#) Attribute Analysis

5.4. [RFC3312](#): Integration of Resource Management and SIP

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

Name	Notes	Level	Mux Category
des	Refer to notes below	M	CAUTION
conf	Refer to notes below	M	CAUTION
curr	Refer to notes below	M	CAUTION

5.4 [RFC3312](#) Attribute Analysis

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

5.5. [RFC4574](#): SDP Label Attribute

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

Name	Notes	Level	Mux Category
label	Not Impacted	M	NORMAL

5.5 [RFC4574](#) Attribute Analysis

5.6. [RFC5432](#): QOS Mechanism Selection in SDP

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

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

5.6 [RFC5432](#) Attribute Analysis

5.7. [RFC4568](#): SDP Security Descriptions

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

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

5.7 [RFC4568](#) Attribute Analysis

5.8. [RFC5762](#): RTP over DCCP

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

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

5.8 [RFC5762](#) Attribute Analysis

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

5.9. [RFC6773](#): DCCP-UDP Encapsulation

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

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

5.9 [RFC6773](#) Attribute Analysis

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

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

5.10. [RFC5506](#): Reduced-Size RTCP in RTP Profile

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

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

5.10 [RFC5506](#) Attribute Analysis

5.11. [RFC6787](#): Media Resource Control Protocol Version 2

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

Name	Notes	Level	Mux Category
resource	Not Impacted	M	NORMAL
channel	Not Impacted	M	NORMAL
cmid	Not Impacted	M	NORMAL

5.11 [RFC6787](#) Attribute Analysis

5.12. [RFC5245](#): ICE

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

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

5.12 [RFC5245](#) Attribute Analysis

5.13. [RFC5285](#): RTP Header Extensions

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

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

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

5.13 [RFC5285](#) Attribute Analysis

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

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

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

5.14 [RFC3605](#) Attribute Analysis

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

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

Name	Notes	Level	Mux Category
ssrc	Refer to Notes below	M	NORMAL
ssrc-group	Refer to Section 9 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 same for a given codec configuration	SR	IDENTICAL-PER-PT

5.15 [RFC5576](#) Attribute Analysis

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

5.16. [RFC7273](#): RTP Clock Source Signalling

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

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

5.16 [RFC7273](#) Attribute Analysis

5.17. [RFC6236](#): Image Attributes in SDP

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

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

5.17 [RFC6236](#) Attribute Analysis

5.18. [RFC7197](#): Duplication Delay Attribute in SDP

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

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

5.18 [RFC7197](#) Attribute Analysis

5.19. [RFC7266](#): RTCP XR Blocks for MOS Metric Reporting

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

Name	Notes	Level	Mux Category
calgextmap	Not Impacted	B	NORMAL

5.19 [RFC7266](#) Attribute Analysis

5.20. [RFC6285](#): Rapid Acquisition of Multicast RTP Sessions

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

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

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

5.20 [RFC6285](#) Attribute Analysis

5.21. [RFC6230](#): Media Control Channel Framework

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

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

5.21 [RFC6230](#) Attribute Analysis

5.22. [RFC6364](#): SDP Elements for FEC Framework

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

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

5.22 [RFC6364](#) Attribute Analysis

5.23. [RFC4796](#): Content Attribute

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

Name	Notes	Level	Mux Category
content	Not Impacted	M	NORMAL

5.23 [RFC4796](#) Attribute Analysis

5.24. [RFC3407](#): SDP Simple Capability Declaration

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

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

5.24 [RFC3407](#) Attribute Analysis

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

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

5.25. [RFC6284](#): Port Mapping between Unicast and Multicast RTP Sessions

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

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

5.25 [RFC6284](#) Attribute Analysis

5.26. [RFC6714](#): MSRP-CEMA

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

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

5.26 [RFC6714](#) Attribute Analysis

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

5.27. [RFC4583](#): SDP Format for BFCP Streams

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

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

5.27 [RFC4583](#) Attribute Analysis

5.28. [RFC5547](#): SDP Offer/Answer for File Transfer

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

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

5.28 [RFC5547](#) Attribute Analysis

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

categories assignments for attributes in this section could be revisited.

5.29. [RFC6849](#): SDP and RTP Media Loopback Extension

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

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

5.29 [RFC6849](#) Analysis

5.30. [RFC5760](#): RTCP with Unicast Feedback

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

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

5.30 [RFC5760](#) Attribute Analysis

5.31. [RFC3611](#): RTCP XR

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

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

5.31 [RFC3611](#) Attribute Analysis

5.32. [RFC5939](#): SDP Capability Negotiation

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

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

5.32 [RFC5939](#) Attribute Analysis

5.33. [RFC6871](#): SDP Media Capabilities Negotiation

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

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

5.33 [RFC6871](#) - Attribute Analysis

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

5.34. [RFC7006](#): Miscellaneous Capabilities Negotiation SDP

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

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

5.34 [RFC7006](#) - Attribute Analysis

5.35. [RFC4567](#): Key Management Extensions for SDP and RTSP

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

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

5.35 [RFC4567](#) Attribute Analysis

5.36. [RFC4572](#): Comedia over TLS in SDP

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

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

5.36 [RFC4572](#) Attribute Analysis**5.37. [RFC4570](#): SDP Source Filters**

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

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

5.37 [RFC4570](#) Attribute Analysis

5.38. [RFC6128](#): RTCP Port for Multicast Sessions

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

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

5.38 [RFC6128](#) Attribute Analysis**5.39. [RFC6189](#): ZRTP**

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

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

5.39 [RFC6189](#) Attribute Analysis

5.40. [RFC4145](#): Connection-Oriented Media

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

Name	Notes	Level	Mux Category
setup	The setup attribute MUST be 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

5.40 [RFC4145](#) Attribute Analysis

5.41. [RFC6947](#): The SDP altc Attribute

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

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

5.41 [RFC6947](#) Attribute Analysis

5.42. [RFC7195](#): SDP Extension for Circuit Switched Bearers in PSTN

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

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

5.42 [RFC7195](#) Attribute Analysis

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

5.43. [RFC7272](#): IDMS Using the RTP Control Protocol (RTCP)

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

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

5.43 [RFC7272](#) Attribute Analysis

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

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

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

5.44 [RFC5159](#) Attribute Analysis

5.45. [RFC6193](#): Media Description for IKE in SDP

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

Name	Notes	Level	Mux Category
ike-setup	Unlikely to use IKE in the 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

5.45 [RFC6193](#) Attribute Analysis

5.46. [RFC2326](#): Real Time Streaming Protocol

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

Name	Notes	Level	Mux Category
etag	RTSP is not supported for RTP Stream multiplexing	B	CAUTION
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

5.46 [RFC2326](#) Attribute Analysis

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

5.47. [RFC6064](#): SDP and RTSP Extensions for 3GPP

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

Name	Notes	Level	Mux Category
X-predecbuFSIZE	Refer to notes below	M	CAUTION
X-initpredecbuFperiod	Refer to notes below	M	CAUTION
X-initpostdecbuFperiod	Refer to notes below	M	CAUTION
X-decbyterate	Refer to notes below	M	CAUTION
3gpp-videopostdecbuFSIZE	Refer to notes below	M	CAUTION
framesize	Refer to notes below	M	CAUTION
3GPP-Integrity-Key	Refer to notes below	S	CAUTION
3GPP-SDP-Auth	Refer to notes below	S	CAUTION
3GPP-SRTP-Config	Refer to notes below	M	CAUTION
alt	Refer to notes below	M	CAUTION
alt-default-id	Refer to notes below	M	CAUTION

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

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

5.47 [RFC6064](#) Attribute Analysis

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

5.48. [RFC3108](#): ATM SDP

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

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

	below		
anycast	Refer to notes	B	CAUTION
	below		
cache	Refer to notes	B	CAUTION
	below		
bearerSigIE	Refer to notes	B	CAUTION
	below		
aalApp	Refer to notes	B	CAUTION
	below		
cbrRate	Refer to notes	B	CAUTION
	below		
sbc	Refer to notes	B	CAUTION
	below		
clkrec	Refer to notes	B	CAUTION
	below		
fec	Refer to notes	B	CAUTION
	below		
prtfl	Refer to notes	B	CAUTION
	below		
structure	Refer to notes	B	CAUTION
	below		
cpsSDUsize	Refer to notes	B	CAUTION
	below		
aal2CPS	Refer to notes	B	CAUTION
	below		
aal2CPSSDURate	Refer to notes	B	CAUTION
	below		
aal2sscs3661unassured	Refer to notes	B	CAUTION
	below		
aal2sscs3661assured	Refer to notes	B	CAUTION
	below		
aal2sscs3662	Refer to notes	B	CAUTION
	below		
aal5sscop	Refer to notes	B	CAUTION
	below		
atmmmap	Refer to notes	B	CAUTION
	below		
silenceSupp	Refer to notes	B	CAUTION
	below		
ecan	Refer to notes	B	CAUTION
	below		
gc	Refer to notes	B	CAUTION
	below		
profileDesc	Refer to notes	B	CAUTION
	below		
vsel	Refer to notes	B	CAUTION
	below		
dsel	Refer to notes	B	CAUTION

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

5.48 [RFC3108](#) Attribute Analysis

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

5.49. 3GPP TS 26.114

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

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

5.49 3GPP TS 26.114 Attribute Analysis

[5.50.](#) 3GPP TS 183.063

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

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

5.50 3GPP TS 183.063 Attribute Analysis

[5.51.](#) 3GPP TS 24.182

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

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

5.51 3GPP TS 24.182 Attribute Analysis

[5.52.](#) 3GPP TS 24.183

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

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

5.52 3GPP TS 24.183 Attribute Analysis

[5.53.](#) 3GPP TS 24.229

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

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

5.53 3GPP TS 24.229 Attribute Analysis

5.54. ITU T.38

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

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

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

5.54 ITU T.38 Attribute Analysis

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

5.55. ITU-T Q.1970

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

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

5.55 ITU-T Q.1970 Attribute Analysis**5.56. ITU-T H.248.15**

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

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

5.56 ITU-T H.248.15 Attribute Analysis

5.57. [RFC4975](#): The Message Session Relay Protocol

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

Name	Notes	Level	Mux Category
accept-types	Refer to notes 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

5.57 [RFC4975](#) Attribute Analysis

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

5.58. Historical Attributes

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

Name	Notes	Level	Mux Category
rtppred1	Historic attributes	M	CAUTION
rtppred2	Historic attributes	M	CAUTION

5.58 Historical Attribute Analysis

6. bwtype Attribute Analysis

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

6.1. [RFC4566](#): SDP

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

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

6.1 [RFC4566](#) bwtype Analysis**6.2. [RFC3556](#): SDP Bandwidth Modifiers for RTCP Bandwidth**

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

Name	Notes	Level	Mux Category
bwtype:RS	Session level usage represents 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

6.2 [RFC3556](#) bwtype Analysis

6.3. [RFC3890](#): Bandwidth Modifier for SDP

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

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

6.3 [RFC3890](#) bwtype Analysis

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

7. rtcp-fb Attribute Analysis

This section analyzes rtcp-fb SDP attributes.

7.1. [RFC4585](#): RTP/AVPF

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

Name	Notes	Level	Mux Category
ack rpsi	The attribute value MUST be 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 same for a given codec configuration	M	IDENTICAL-PER-PT
nack pli	The attribute value MUST be same for a given codec configuration	M	IDENTICAL-PER-PT
nack sli	The attribute value MUST be same for a given codec configuration	M	IDENTICAL-PER-PT
nack rpsi	The attribute value MUST be 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 same for a given codec configuration	M	IDENTICAL-PER-PT

7.1 [RFC4585](#) Attribute Analysis

7.2. [RFC5104](#): Codec Control Messages in AVPF

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

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

7.2 [RFC5104](#) Attribute Analysis

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

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

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

7.3 [RFC6285](#) Attribute Analysis

7.4. [RFC6679](#): ECN for RTP over UDP/IP

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

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

7.4 [RFC6679](#) Attribute Analysis

7.5. [RFC6642](#): Third-Party Loss Report

In a large RTP session using the RTCP feedback mechanism defined in [\[RFC4585\]](#), a feedback target may experience transient overload if some event causes a large number of receivers to send feedback at once. This overload is usually avoided by ensuring that feedback reports are forwarded to all receivers, allowing them to avoid sending duplicate feedback reports. However, there are cases where it is not recommended to forward feedback reports, and this may allow feedback implosion. [\[RFC6642\]](#) memo discusses these cases and defines a new RTCP Third-Party Loss Report that can be used to inform receivers that the feedback target is aware of some loss event, allowing them to suppress feedback. Associated SDP signaling is also defined.

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

7.5 [RFC6642](#) Attribute Analysis

7.6. [RFC5104](#): Codec Control Messages in AVPF

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

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

7.6 [RFC5104](#) Attribute Analysis

8. group Attribute Analysis

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

8.1. [RFC5888](#): SDP Grouping Framework

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

Name	Notes	Level	Mux Category
group:LS	Not Impacted	S	NORMAL
group:FID	Not Impacted	S	NORMAL

8.1 [RFC5888](#) Attribute Analysis

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

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

Name	Notes	Level	Mux Category
group:SRF	Not Impacted	S	NORMAL

8.2 [RFC3524](#) Attribute Analysis

8.3. [RFC4091](#): ANAT Semantics

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

Name	Notes	Level	Mux Category
group:ANAT	ANAT semantics is obsoleted	S	CAUTION

8.3 [RFC4091](#) Attribute Analysis

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

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

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

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

8.4 [RFC5956](#) Attribute Analysis

8.5. [RFC5583](#): Signaling Media Decoding Dependency in SDP

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

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

8.5 [RFC5583](#) Attribute Analysis

8.6. [RFC7104](#): Duplication Grouping Semantics in the SDP

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

Name	Notes	Level	Mux Category
group:DUP	Not Impacted	S	NORMAL

8.6 [RFC7104](#) Attribute Analysis

9. **ssrc-group Attribute Analysis**

This section analyzes "ssrc-group" semantics.

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

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

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

9.1 [RFC5576](#) Attribute Analysis

9.2. [RFC7104](#): Duplication Grouping Semantics in the SDP

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

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

9.2 [RFC7104](#) Attribute Analysis

10. QoS Mechanism Token Analysis

This section analyzes QoS tokens specified with SDP.

10.1. [RFC5432](#): QoS Mechanism Selection in SDP

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

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

10.1 [RFC5432](#) Attribute Analysis

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

11. k= Attribute Analysis

11.1. [RFC4566](#): SDP

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

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

11.1 [RFC4566](#) Attribute Analysis**12. content Attribute Analysis****12.1. [RFC4796](#)**

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

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

12.1 [RFC4796](#) Attribute Analysis

13. Payload Formats

13.1. [RFC5109](#): RTP Payload Format for Generic FEC

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

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

13.1 [RFC5109](#) Payload Format Analysis

14. Multiplexing Considerations for Encapsulating Attributes

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

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

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

14.1. [RFC3407](#): cpar Attribute Analysis

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

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

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

14.2. [RFC5939](#) Analysis

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

For this purpose, [[RFC5939](#)] defines the following

- o A set of capabilities for the session and its associated media stream components, supported by each side. The attribute ("a=acap") defines how to list an attribute name and its associated value (if any) as a capability. The attribute ("a=tcap") defines how to list transport protocols (e.g., "RTP/AVP") as capabilities.
- o A set of potential configurations ("a=pcfg") provided by the offerer to indicate which combinations of those capabilities can be used for the session and its associated media stream

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

- o An actual configuration ("a=acfg") for the session and its associated media stream components. The actual configuration identifies the potential configuration that was negotiated for use. Use of an actual configuration does not require any further negotiation.
- o A negotiation process that takes the current actual and the set of potential configurations (combinations of capabilities) as input and provides the negotiated actual configurations as output. In [\[RFC5939\]](#) the negotiation process is done independently for each media description.

14.2.1. Recommendation: Procedures for Potential Configuration Pairing

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

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

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

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

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

group, we provide a simple rule for constructing potential configurations

- o Let m-bundle be the set of media descriptions that form a given bundle .
- o Let m-bundle-pcfg be the set of media descriptions in m-bundle that include one or more potential configurations.
- o Each media description in m-bundle-pcfg MUST have at least one potential configuration with the same configuration number (e.g. "1").
- o For each potential configuration with configuration number x in m-bundle-pcfg, the offerer MUST ensure that if the answerer chooses configuration number x in each of the media descriptions in m-bundle-pcfg, then the resulting SDP will have all multiplexing constraints satisfied for those media descriptions.
- o Since it is nearly impossible to define a generic mechanism for various capability extensions, this document doesn't provide procedures for dealing with the capability extension attributes. However, [Section 14.3](#) provide analysis of media capability extension attributes as defined in [\[RFC6871\]](#).

The above allows the answerer to easily find multiplexing compatible combinations of potential configurations: The answerer simply 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 the example above, the potential configurations that offer transport protocol capability of RTP/SAVPF has the same configuration number "1" in both the audio and video media descriptions.

14.2.1.2. Example: Attribute Capability Multiplexing

```
v=0
o=alice 2890844526 2890844527 IN IP4 host.atlanta.example.com
s=
c=IN IP4 host.atlanta.example.com
t=0 0
a=acap:1 a=rtcp-mux
a=acap:2 a=crypto:1 AES_CM_128_HMAC_SHA1_80
    inline:EcGZiNWpFJhQXdspcl1ekcmVCNWpVLcfHAWJSoj|2^20|1:32
a=group:BUNDLE audio video
m=audio 49172 RTP/AVP 99
a=mid:audio
a=pcfg:1 a=1
a=pcfg:2
m=video 560024 RTP/AVP 100
a=mid:video
a=pcfg:1 a=1
a=pcfg:2 a=2
```

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

14.3. RFC6871 Analysis

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

14.3.1. Recommendation: Dealing with Payload Type Numbers

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

14.3.1.1. Example: Attribute Capability Under Shared Payload Type

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


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

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

14.3.2. Recommendation: Dealing with Latent Configurations

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

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

15. IANA Considerations

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

[Section 15.1](#) defines a new subregistry for identifying the initial registrations for various multiplexing categories applicable, as proposed in this document.

The IANA is requested to add a new column named "Mux Category" to several of the subregistries in the "Session Description Protocol (SDP) Parameters" registry. The tables in [Section 15.2](#) identify name of an entry in the existing subregistry and specify the value to put in the new "Mux Category" column of the associated IANA registry. Any entries in the existing tables that do not have a value for the "Mux Category" specified in this RFC will get a value of "TBD". Future specifications can change the "TBD" entries to the correct value.

15.1. New 'Multiplexing Categories' subregistry

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

Initial value registration for "Multiplexing Categories".

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

Further entries can be registered on a first-come first-serve basis. Each registration needs to indicate the multiplexing category value to be added to the "Multiplexing Categories" subregistry as defined in this section.

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

15.2. 'Mux Category' column for subregistries

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

15.2.1. Table: SDP bwtype

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

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

15.2.2. Table: att-field (session level)

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

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

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

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

NOTE: The attributes from [draft-ietf-rmt-flute-sdp](#) ('flute-tsi', 'flute-ch', 'FEC-declaration', 'FEC-OTI-extension', 'content-desc') were not analyzed for their multiplexing behavior due to the expired status of the draft. For purposes of this specification, the multiplexing category of 'TBD' is assigned.

SDP Name	Mux Category
recvonly	NORMAL
sendrecv	NORMAL

| sendonly	| NORMAL	|
| sdplang	| NORMAL	|
| lang	| NORMAL	|
| h248item	| SPECIAL	|
| sqn	| NORMAL	|
| cdsc	| NORMAL	|
| cpar	| INHERIT	|
| cparmin	| SPECIAL	|
| cparmax	| SPECIAL	|
| rtcp-xr	| NORMAL	|
| maxprate	| SPECIAL	|
| setup	| TRANSPORT	|
| connection	| TRANSPORT	|
| key-mgmt	| IDENTICAL	|
| source-filter	| IDENTICAL	|
| inactive	| NORMAL	|
| fingerprint	| TRANSPORT	|
| flute-tsi	| TBD	|
| flute-ch	| TBD	|
| FEC-declaration	| TBD	|
| FEC-OTI-extension	| TBD	|
| content-desc	| TBD	|
| ice-pwd	| TRANSPORT	|
| ice-ufrag	| TRANSPORT	|
| stkmstream	| NORMAL	|
| extmap	| SPECIAL	|
| qos-mech-send	| TRANSPORT	|
| qos-mech-recv	| TRANSPORT	|
| csup	| NORMAL	|
| creq	| NORMAL	|
| acap	| INHERIT	|
| tcap	| INHERIT	|
| 3GPP-QoE-Metrics	| CAUTION	|
| 3GPP-Asset-Information	| CAUTION	|
| mbms-mode	| CAUTION	|
| mbms-repair	| CAUTION	|
| ike-setup	| IDENTICAL	|
| psk-fingerprint	| IDENTICAL	|
| multicast-rtcp	| IDENTICAL	|
| rmcap	| IDENTICAL-PER-PT	|
| omcap	| NORMAL	|
| mfcap	| IDENTICAL-PER-PT	|
| mscap	| INHERIT	|
| 3gpp.iut.replication	| TBD	|
| bcap	| INHERIT	|
| ccap	| IDENTICAL	|
| icap	| NORMAL	|
| 3gpp_sync_info	| NORMAL	|

| 3gpp_MaxRecvSDUSize	| NORMAL	|
| etag	| CAUTION	|
| duplication-delay	| NORMAL	|
| range	| CAUTION	|
| control	| CAUTION	|
| mtag	| CAUTION	|
| ts-refclk	| NORMAL	|
| mediack	| NORMAL	|
| calgextmap	| NORMAL	|
+-----+		

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

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

+-----+		
| SDP Name	| Mux Category	|
+-----+		
|ptime	| IDENTICAL-PER-PT	|
|orient	| NORMAL	|
|orient:portrait	| NORMAL	|
|orient:landscape	| NORMAL	|
|orient:seascape	| NORMAL	|
|framerate	| IDENTICAL-PER-PT	|
|quality	| NORMAL	|
|rtptime	| IDENTICAL-PER-PT	|
|fmt	| IDENTICAL-PER-PT	|
|rtptime1	| CAUTION	|
|rtptime2	| CAUTION	|
|T38FaxVersion	| TBD	|
|T38MaxBitRate	| TBD	|
|T38FaxFillBitRemoval	| TBD	|
|T38FaxTranscodingMMR	| TBD	|
|T38FaxTranscodingJBIG	| TBD	|
|T38FaxRateManagement	| TBD	|
|T38FaxMaxBuffer	| TBD	|
|T38FaxMaxDatagram	| TBD	|
|T38FaxUdpEC	| TBD	|
|maxptime	| IDENTICAL-PER-PT	|
|des	| CAUTION	|
|curr	| CAUTION	|
|conf	| CAUTION	|
|mid	| NORMAL	|
|rtcp	| TRANSPORT	|
|rtcp-fb	| IDENTICAL-PER-PT	|

| label	| NORMAL	|
| T38VendorInfo	| TBD	|
| crypto	| TRANSPORT	|
| eecid	| CAUTION	|
| aalType	| CAUTION	|
| capability	| CAUTION	|
| qosClass	| CAUTION	|
| bcob	| CAUTION	|
| stc	| CAUTION	|
| upcc	| CAUTION	|
| atmQOSparms	| CAUTION	|
| atmTrfcDesc	| CAUTION	|
| abrParms	| CAUTION	|
| abrSetup	| CAUTION	|
| bearerType	| CAUTION	|
| lij	| CAUTION	|
| anycast	| CAUTION	|
| cache	| CAUTION	|
| bearerSigIE	| CAUTION	|
| aalApp	| CAUTION	|
| cbrRate	| CAUTION	|
| sbc	| CAUTION	|
| clkrec	| CAUTION	|
| fec	| CAUTION	|
| prtfl	| CAUTION	|
| structure	| CAUTION	|
| cpsSDUsize	| CAUTION	|
| all2CPS	| CAUTION	|
| all2CPSSDURate	| CAUTION	|
| aal2sscs3661unassured	| CAUTION	|
| aal2sscs3661assured	| CAUTION	|
| aal2sscs3662	| CAUTION	|
| aal5sscscop	| CAUTION	|
| atmmmap	| CAUTION	|
| silenceSupp	| CAUTION	|
| ecan	| CAUTION	|
| gc	| CAUTION	|
| profileDesc	| CAUTION	|
| vsel	| CAUTION	|
| dsel	| CAUTION	|
| fsel	| CAUTION	|
| onewaySel	| CAUTION	|
| codecconfig	| CAUTION	|
| isup_usi	| CAUTION	|
| uiLayer1_Prot	| CAUTION	|
| chain	| CAUTION	|
| floorctrl	| IDENTICAL	|
| confid	| NORMAL	|

| userid	| NORMAL	|
| floorid	| NORMAL	|
| FEC	| NORMAL	|
| accept-types	| TBD	|
| accept-wrapped-types	| TBD	|
| max-size	| TBD	|
| path	| TBD	|
| dccp-service-code	| CAUTION	|
| rtcp-mux	| IDENTICAL	|
| candidate	| TRANSPORT	|
| ice-mismatch	| NORMAL	|
| remote-candidates	| TRANSPORT	|
| SRTPAuthentication	| TBD	|
| SRTPROCTxRate	| TBD	|
| rtcp-rsize	| IDENTICAL	|
| file-selector	| TBD	|
| file-transfer-id	| TBD	|
| file-disposition	| TBD	|
| file-date	| TBD	|
| file-icon	| TBD	|
| file-range	| TBD	|
| depend	| IDENTICAL-PER-PT	|
| ssrc	| NORMAL	|
| ssrc-group	| NORMAL	|
| rtcp-unicast	| IDENTICAL	|
| pcfg	| SPECIAL	|
| acfg	| SPECIAL	|
| zrtp-hash	| TRANSPORT	|
| X-predecbufsize	| CAUTION	|
| X-initpredecbufperiod	| CAUTION	|
| X-initpostdecbufperiod	| CAUTION	|
| X-decbyterate	| CAUTION	|
| 3gpp-videopostdecbufsize	| CAUTION	|
| framesize	| CAUTION	|
| 3GPP-SRTP-Config	| CAUTION	|
| alt	| CAUTION	|
| alt-default-id	| CAUTION	|
| 3GPP-Adaption-Support	| CAUTION	|
| mbms-flowid	| CAUTION	|
| fec-source-flow	| SPECIAL	|
| fec-repair-flow	| SPECIAL	|
| repair-window	| SPECIAL	|
| rams-updates	| CAUTION	|
| imageattr	| IDENTICAL-PER-PT	|
| cfw-id	| NORMAL	|
| portmapping-req	| CAUTION	|
| g.3gpp.cat	| NORMAL	|
| g.3gpp.crs	| NORMAL	|

| ecn-capable-rtp	| IDENTICAL	|
| visited-realm	| TRANSPORT	|
| secondary-realm	| TRANSPORT	|
| omr-s-cksum	| NORMAL	|
| omr-m-cksum	| NORMAL	|
| omr-codecs	| NORMAL	|
| omr-m-att	| NORMAL	|
| omr-s-att	| NORMAL	|
| omr-m-bw	| NORMAL	|
| omr-s-bw	| NORMAL	|
| msrp-cema	| TBD	|
| dccp-port	| CAUTION	|
| resource	| NORMAL	|
| channel	| NORMAL	|
| cmid	| NORMAL	|
| content	| NORMAL	|
| lcfg	| SPECIAL	|
| loopback	| NORMAL	|
| loopback-source	| NORMAL	|
| loopback-mirror	| NORMAL	|
| chatroom	| TBD	|
| altc	| TRANSPORT	|
| T38FaxMaxIFP	| TBD	|
| T38FaxUdpECDepth	| TBD	|
| T38FaxUdpFECMaxSpan	| TBD	|
| T38ModemType	| TBD	|
| cs-correlation	| TBD	|
| rtcp-idms	| NORMAL	|
+-----+		

15.2.5. Table: att-field (source level)

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

+-----+		
| SDP Name	| Mux Category	|
+-----+		
| cname	| NORMAL	|
| previous-ssrc	| NORMAL	|
| fntp	| IDENTICAL-PER-PT	|
| ts-refclk	| NORMAL	|
| mediacclk	| NORMAL	|
+-----+		

15.2.6. Table: content SDP Parameters

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

SDP Name	Mux Category
slides	NORMAL
speaker	NORMAL
sl	NORMAL
main	NORMAL
alt	NORMAL

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

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

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

15.2.8. Table: 'rtcp-fb' Attribute Values

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

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

[15.2.9.](#) Table: 'ack' and 'nack' Attribute Values

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

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

[15.2.10.](#) Table: 'depend' SDP Attribute Values

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

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

15.2.11. Table: 'cs-correlation' Attribute Values

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

Value	Mux Category
callerid	TBD
uuie	TBD
dtmf	TBD
external	TBD

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

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

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

15.2.13. Table: SDP/RTSP key management protocol identifiers

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

Value Name	Mux Category
mikey	IDENTICAL

15.2.14. Table: Codec Control Messages

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

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

15.2.15. Table: QoS Mechanism Tokens

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

QoS Mechanism	Mux Category
rsvp	TRANSPORT
nsis	TRANSPORT

15.2.16. Table: SDP Capability Negotiation Option Tags

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

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

15.2.17. Table: Timestamp Reference Clock Source Parameters

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

Name	Mux Category
ntp	NORMAL
ptp	NORMAL
gps	NORMAL
gal	NORMAL
glonass	NORMAL
local	NORMAL
private	NORMAL

15.2.18. Table: Media Clock Source Parameters

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

Name	Mux Category
sender	NORMAL
direct	NORMAL
IEEE1722	NORMAL

16. Security Considerations

This document does not add any new security considerations beyond the existing considerations in the RFCs for protocols that are being multiplexed together.

The ways that SRTP streams are keyed is not believed to create any two-time pad vulnerability for the currently defined SRTP keying mechanism.

17. Acknowledgments

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Thanks to Ben Campbell for AD review suggestions.

18. Change Log

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

Changes from [draft-ietf-mmusic-sdp-mux-attributes-10](#) - [draft-ietf-mmusic-sdp-mux-attributes-13](#)

- o Incorporated Comments from WGLC review and AD Evaluation

Changes from [draft-ietf-mmusic-sdp-mux-attributes-10](#)

- o Incorporated Comments from Bo Burman for publication request

Changes from [draft-ietf-mmusic-sdp-mux-attributes-08](#) to [draft-ietf-mmusic-sdp-mux-attributes-10](#)

- o Minor nits and version update to advert expiration

Changes from [draft-ietf-mmusic-sdp-mux-attributes-06](#) to [draft-ietf-mmusic-sdp-mux-attributes-08](#)

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

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

Changes from [draft-ietf-mmusic-sdp-mux-attributes-06](#)

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

- o Fixed more nits to prep for the LastCall.

Changes from [draft-ietf-mmusic-sdp-mux-attributes-05](#)

- o Incorporated review comments from Christian Grooves and Ari Keranen.

- o Fixed more nits to prep for the LastCall.

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

- o Fixed minor nits overall.

- o Updated Acknowledgement Sections

- o Last Call Version.

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

- o More re-work on the IANA section.

- o Clean ups preparing for the last call.

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

- o Incorporated suggestions from Flemming on Capability Negotiation.

- o Closed open issues from IETF90

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

- o Lots of cleanup

- o Reformatted References section to use short-form notation

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

- o Updated [section 15](#) to provide detailed recommendation on dealing with encapsulating attributes. Also updated sections [5.20](#), [5.28](#), [5.29](#) to refer to [Section 15](#).
- o Added new categories IDENTICAL-PER-PT and INHERIT
- o Updated Sections [16](#) to add the new categories.
- o Updated Sections [5.1](#), [5.14](#), [5.15](#), [5.38](#), [8.5](#) to reflect the category IDENTICAL-PER-PT.
- o Reformatted [section 4](#) to add individual categories to their own sections.

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

- o Added [Section 15](#) to provide recommendations on multiplexing SDP encapsulating attributes. Also updated sections [5.20](#), [5.28](#), [5.29](#) to refer to [Section 15](#).
- o Updated [Section 5.38](#) to incorporate PM-dir review inputs from Qin Wu
- o Updated Sections [5.2](#), [5.14](#), [8.5](#) to refer to BUNDLE draft for more clarity.
- o Fixed few nits regarding sentence clarity and fill-in the NOTES section where information was lacking.

Changes from [draft-nandakumar-mmusic-mux-attributes-05](#)

- o Renamed the document to be a WG document.
- o Added [Section 14](#).
- o Updated Open Issues based on IETF88 discussions.

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

- o Added few OPEN ISSUES that needs to be discussed.
- o Updated sections [5.10](#), [5.23](#), [5.24](#), [5.25](#), [7.2](#), [9.1](#), [5.12](#), [5.27](#), [8.4](#), [5.44](#), [5.11](#), [5.4](#), [5.19](#), [10.1](#), [10.5](#), [5.21](#), [10.4](#), [15.1](#)
- o Updated Table Column name Current to Level and improved TRANSPORT category explanation on suggestions from Dan Wing.

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

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

- o Maintenance change to clean up grammatical nits and wordings.

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

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

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

- o Replaced Category BAD with NOT-RECOMMENDED.
- o Added Category TBD.
- o Updated IANA Consideration Section.

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

- o Added new section for dealing with FEC payload types.

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Author's Address

Suhas Nandakumar
Cisco
170 West Tasman Drive
San Jose, CA 95134
USA

Email: snandaku@cisco.com

