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SDP for the WebRTC
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Abstract

The Web Real-Time Communication [WebRTC] working group is charged to provide protocol support for direct interactive rich communication using audio, video and data between two peers' web browsers. With in the WebRTC framework, Session Description protocol (SDP) [RFC4566] is used for negotiating session capabilities between the peers. Such a negotiation happens based on the SDP Offer/Answer exchange mechanism described in the RFC 3264 [RFC3264].

This document provides an informational reference in describing the role of SDP and the Offer/Answer exchange mechanism for the most common WebRTC use-cases.

This SDP examples provided in this document is still a work in progress, but it aims to align closest to the evolving standards work.

Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on August 16, 2014.

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1. Introduction

Javascript Session Exchange Protocol(JSEP) [JSEP] specifies a generic protocol needed to generate [RFC3264] Offers and Answers negotiated between the WebRTC peers for setting up, updating and tearing down a WebRTC session. For this purpose, SDP is used to construct [RFC3264] Offers/Answers for describing (media and non-media) streams as appropriate for the recipients of the session description to participate in the session.

The remainder of this document is organized as follows: Section 3 and 4 provides an overview of SDP and the Offer/Answer exchange mechanism. Section 5 provides sample SDP generated for the most common WebRTC use-cases.

2. Terminology

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

3. SDP and the WebRTC

The purpose of this section is to provide a general overview of SDP and its components. For a more in-depth understanding, the readers are advised to refer to [RFC4566].

The Session Description Protocol (SDP) [RFC4566] describes multimedia sessions, which can contain audio, video, whiteboard, fax, modem, and other streams. SDP provides a general purpose, standard representation to describe various aspects of multimedia session such as media capabilities, transport addresses and related metadata in a transport agnostic manner, for the purposes of session announcement, session invitation and parameter negotiation.

As of today SDP is widely used in the context of Session Initiation Protocol [RFC3261], Real-time Transport Protocol [RFC3550] and Real-time Streaming Protocol applications [RFC2326].

Below figure introduces high-level breakup of SDP into components that semantically describe a multimedia session, in our case, a WebRTC session [WebRTC]. It by no means captures everything about SDP and hence, should be used for informational purposes only.

[WebRTC] proposes JavaScript application to fully specify and control the signaling plane of a multimedia session as described in the JSEP

specification [JSEP]. JSEP provides mechanisms to create session characterization and media definition information to conduct the session based on SDP exchanges.

In this context, SDP serves two purposes:
1. Provide grammatical structure syntactically.
2. Semantically convey partipant's intention and capabilities required to successfully negotiate a session.

4. Offer/Answer and the WebRTC

This section introduces SDP Offer/Answer Exchange mechanism mandated by WebRTC for negotiating session capabilities while setting up, updating and tearing down a WebRTC session. This section is intentionally brief in nature and interested readers are recommended to refer [RFC3264] for specific details on the protocol operation.

The Offer/Answer [RFC3264] model specifies rule for the bilateral exchange of Session Description Protocol (SDP) messages for creation of multimedia streams. It defines protocol with involved participants exchanging desired session characteristics from each

others perspective constructed as SDP to negotiate the session between them.

In the most basic form,the protocol operation begins by one of the participants sending an initial SDP Offer describing its intent to start a multimedia communication session. The participant receiving the offer MAY generate an SDP Answer accepting the offer or it MAY reject the offer. If the session is accepted the Offer/Answer model guarantees a common view of the multimedia session between the participants.

At any time, either participant MAY generate a new SDP offer that updates the session in progress.

With in the context of WebRTC, the Offer/Answer model defines the state-machinery for WebRTC peers to negotiate session descriptions between them during the initial setup stages as well as for eventual session updates. Javascript Session Establishment Protocol specification [JSEP] for WebRTC provides the mechanism for generating [RFC3264] SDP Offers and Answers in order for both sides of the session to agree upon details such as list of media formats to be sent/received, bandwidth information, crypto parameters, transport parameters, for example.

5. WebRTC Session Description Examples

A typical web based real-time multimedia communication session can be characterized as below:

- It has zero or more Audio only, Video only or Audio/Video RTP Sessions,
- MAY contain zero or more non-media data sessions,
- All the sessions are secured with DTLS-SRTP,
- Supports NAT traversal using ICE mechanism,
- Provides RTCP based feedback mechanisms,
- Sessions can be over IPv4-only, IPv6-only, dual-stack based clients.

5.1. Some Conventions

The examples given in this document follow the conventions listed below:

- In all the examples, Alice and Bob are assumed to be the WebRTC peers.
- [draft-ietf-mmusic-sdp-bundle-negotiation] support for multiplexing several media streams on a single underlying transport is enabled by default unless explicitly specified otherwise.
- Call flow diagrams that accompany the use-cases capture only the prominent aspects of the system behavior and intentionally is not detailed to improve readability.
- The SDP examples deviate from actual on-the-wire SDP notation in several ways. This is done to facilitate readability and to conform to the restrictions imposed by the RFC formatting rules.
  * Any SDP line that is indented (compared to the initial line in the SDP block) is a continuation of the preceding line. The line break and indent are to be interpreted as a single space character.
  * Empty lines in any SDP example are inserted to make functional divisions in the SDP clearer, and are not actually part of the SDP syntax.
  * Excepting the above two conventions, line endings are to be interpreted as <CR><LF> pairs (that is, an ASCII 13 followed by an ASCII 10).
- Against each SDP line, pointers to the appropriate RFCs are provide for further information reference. Also an attempt has been made to provide explanatory notes to enable better understanding of the SDP usage, wherever appropriate.
- Following SDP details are common across all the use-cases defined in this document unless mentioned otherwise.

  * DTLS fingerprint for SRTP (a=fingerprint)
  * RTP/RTCP Multiplexing (a=rtcp-mux)
  * RTCP Feedback support (a=rtcp-fb)
  * Host and server-reflexive candidate lines (a=candidate)
  * SRTP Setup framework parameters (a=setup)
  * RTCP attribute (a=rtcp)
  * RTP header extension indicating audio-levels from client to the mixer

For more details, readers are recommended to refer to the Javascript Session Exchange Protocol(JSEP) [JSEP] specification.

- The term "Session" is used rather loosely in this document to refer to either a "Communication Session" or a "RTP Session" or a "RTP Stream" depending on the context.
- Payload type 109 is usually used for OPUS, 99 for H.264 and 120 for VP8 in most of the examples to maintain uniformity.
- In the actual use that values that represent SSRCs, ICE candidate foundations, WebRTC Mediastream and MediaStreamTrack Ids can be much larger and random than the ones shown in the examples.

[OPEN ISSUE-1]: SDP Examples for Data Channel, Simulcast, SVC are still being discussed and doesn't represent the final solution.
[OPEN ISSUE-2]: API surface for controlling BUNDLE, TRICKLE-ICE are ignored for the time being.

5.2. Basic Examples

5.2.1. Two-Way Audio Only Session

This common scenario shows SDP for secure Two-way audio session with Alice offering Opus, PCMU, PCMA and Bob accepting all the audio codecs offered.

```
title 2-Way Audio Only Session

participant Alice as Alice
participant Bob as Bob

Alice->Bob: Offer(Audio:Opus,PCMU,PCMA)
Bob->Alice: Answer(Audio:Opus,PCMU,PCMA)
Alice<->Bob: Two-way Opus Audio (preferred codec)
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio	[draft-ietf-mmusic-sdp-bundle-negotiation]
m=audio 54609 UDP/TLS/RTP/SAVPF 109 0 8	[RFC4566]
a=mid:audio	[RFC5888]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605] - Port for RTCP data
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus] - Opus Codec 48khz, 2 channels
a=ptime:20	[draft-ietf-payload-rtp-opus] - Opus packetization of20ms
a=rtpmap:0 PCMU/8000	[RFC3551] PCMU Audio Codec
a=rtpmap:8 PCMA/8000	[RFC3551] PCMA Audio Codec
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464] Alice supports RTP header extension to indicate audio levels
a=sendrecv	[RFC3264] - Alice can send and recv audio
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761] - Alice can perform RTP/RTCP Muxing on port 54609
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245] - DTLS Fingerprint for SRTP
a=ice-ufrag:074c6550	[RFC5245] - ICE user fragment
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245] - ICE password

a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245] - RTP Host Candidate
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245] - RTP Server Reflexive ICE Candidate
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245] - RTCP Host Candidate
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245] - RTCP Server Reflexive Candidate
a=rtcp-fb:109 nack	[RFC5104] - Indicates NACK RTCP feedback support
a=ssrc:12345 cname:EocUG1f0fcg/yvY7	[RFC5576]
a=rtcp-rsize	[RFC5506] - Alice intends to use reduced size RTCP for this session
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]

Table 1: 5.2.1 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio	[draft-ietf-mmusic-sdp-bundle-negotiation]
m=audio 49203 UDP/TLS/RTP/SAVPF 109 0 8	[RFC4566]
a=mid:audio	[RFC5888]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605] - Port for RTCP data
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus] Opus Codec
a=ptime:20	[draft-ietf-payload-rtp-opus] Packetization of 20ms
a=rtpmap:0 PCMU/8000	[RFC3551] PCMU Audio Codec
a=rtpmap:8 PCMA/8000	[RFC3551] PCMA Audio Codec
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464] Bob supports audio level RTP header extension as well
a=sendrecv	[RFC3264] - Bob can send and recv audio
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761] - Bob can perform RTP/RTCP Muxing on port 49203
a=fingerprint:sha-1	[RFC5245] - DTLS

c9:c7:70:9d:1f:66:79:a8:07:99:41:49: 83:4a:97:0e:1f:ef:6d:f7	Fingerprint for SRTP
a=ice-ufrag:05067423	[RFC5245] - ICE user fragment
a=ice-pwd:1747d1ee3474a28a397a4c3f3af08a068	[RFC5245] - ICE password parameter
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245] - RTP Host ICE Candidate for Opus Stream

a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245] - RTP Server Reflexive ICE Candidate
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245] - RTCP Host Candidate
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245] - RTCP Server Reflexive Candidate
a=rtcp-fb:109 nack	[RFC5104] - Indicates NACK RTCP feedback support
a=ssrc:54321 cname:NWs1ao1HmN4Xa5/yvY7	[RFC5576]
a=rtcp-rsize	[RFC5506] - Bob intends to use reduced size RTCP for this session
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]

Table 2: 5.2.1 SDP Answer

5.2.2. Two-Way Audio/Video Session

Alice and Bob establish an audio and video session with Opus as the audio codec and H.264 as the video codec. This example also illustrates the negotiation of NACK based RTCP feedback mechanisms - PLI and FIR for the video session [RFC5104].

```
title 2-Way Audio,Video Session

Alice->Bob: Offer(Audio:Opus,PCMU,PCMA Video:H.264,VP8)
Bob->Alice: Answer(Audio:Opus, Video:H.264)
```

Alice->Bob: Two-way Opus Audio, H.264 Video

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video	[draft-ietf-mmusic-sdp-bundle-negotiation]
m=audio 54609 UDP/TLS/RTP/SAVPF 109 0 8	[RFC4566]
a=mid:audio	[RFC5888]

a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605] - Port for RTCP data
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus] - Opus Codec 48khz, 2 channels
a=ptime:20	[draft-ietf-payload-rtp-opus] - Opus packetization of20ms
a=rtpmap:0 PCMU/8000	[RFC3551] PCMU Audio Codec
a=rtpmap:8 PCMA/8000	[RFC3551] PCMA Audio Codec
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=sendrecv	[RFC3264] - Alice can send and recv audio
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761] - Alice can perform RTP/RTCP Muxing on

	port 54609
a=ice-ufrag:074c6550	[RFC5245] - ICE user fragment
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245] - ICE password parameter
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245] - DTLS Fingerprint for SRTP
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245] - RTP ICE Candidate
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245] - RTP Server Reflexive ICE Candidate
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245] - RTCP Host Candidate
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245] - RTCP Server Reflexive Candidate.
a=rtcp-fb:109 nack	[RFC5104] - Indicates NACK RTCP feedback support
a=ssrc:12345 cname:EocUG1f0fcg/yvY7	[RFC5576]

a=rtcp-rsize	[RFC5506] - Alice intends to use reduced size RTCP for this session
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=video 54609 UDP/TLS/RTP/SAVPF 99 120	[RFC4566]
a=mid:video	[RFC5888]
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605] - Port for RTCP data
a=rtpmap:99 H264/90000	[RFC3984] - H.264 Video Codec
a=fmtp:99	[RFC3984]

profile-level-id=4d0028;packetizatio n-mode=1	
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8] - VP8 video codec
a=sendrecv	[RFC3264] - Alice can send and recv video
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761] - Alice can perform RTP/RTCP Muxing on port 62537
a=ice-ufrag:074c6550	[RFC5245] - ICE user fragment
a=ice-pwd:a28a397a4c3f31747d1ee3474a f08a068	[RFC5245] - ICE password parameter
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07	[RFC5245] - DTLS Fingerprint for SRTP
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245] - RTP Host ICE Candidate
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245] - RTP Server Reflexive ICE Candidate
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245] - RTCP Host Candidate
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245] - RTCP Server Reflexive Candidate

a=rtcp-fb:99 nack	[RFC5104] - Indicates NACK RTCP feedback support
a=rtcp-fb:99 nack pli	[RFC5104] - Indicates support for Picture loss Indication and NACK
a=rtcp-fb:99 ccm fir	[RFC5104] - Full Intra Frame Request-Codec Control Message support
a=rtcp-fb:120 nack	[RFC5104] - Indicates NACK RTCP feedback support
a=rtcp-fb:120 nack pli	[RFC5104] - Indicates

	support for Picture loss Indication and NACK
a=rtcp-fb:120 ccm fir	[RFC5104] - Full Intra Frame Request-Codec Control Message support
a=ssrc:1366781083 cname:EocUG1f0fcg/yvY7	[RFC5576]
a=rtcp-rsize	[RFC5506] - Alice intends to use reduced size RTCP for this session
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]

Table 3: 5.2.2 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video	[draft-ietf-mmusic-sdp-bundle-negotiation]
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=mid:audio	[RFC5888]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605] - Port for RTCP data

a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus] - Bob accepts only OpusCodec
a=extmap:1	[RFC6464]

urn:ietf:params:rtp-hdrext:ssrc-audio-level	
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=sendrecv	[RFC3264] - Bob can send and recv audio
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761] - Bob can perform RTP/RTCP Muxing on port 49203
a=ice-ufrag:c300d85b	[RFC5245] - ICE username frag
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245] - ICE password
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245] - DTLS Fingerprint for SRTP
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245] - RTP Host ICE Candidate for Opus Stream
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245] - RTP Server Reflexive ICE Candidate
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245] - RTPC Host Candidate
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245] - RTCP Server Reflexive Candidate.
a=ssrc:1366788312 cname:1f0fcgEocUG/yvY7	[RFC5576]
a=rtcp-rsize	[RFC5506] - Bob intends to use reduced size RTCP for this session
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=video 49203 UDP/TLS/RTP/SAVPF 99	[RFC4566]
a=mid:video	[RFC5888]
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 98.248.92.77	[RFC4566]

a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605] - Port for RTCP data
a=rtpmap:99 H264/90000	[RFC3984] - Bob accepts H.264 Video Codec.
a=fmtp:99 profile-level-id=4d0028;packetization-mode=1	[RFC3984]
a=sendrecv	[RFC3264] - Bob can send and recv video
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761] - Bob can perform RTP/RTCP Muxing on port 63130
a=ice-ufrag:c300d85b	[RFC5245] - ICE username frag
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245] - ICE password
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245] - DTLS Fingerprint for SRTP
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245] - Host ICE Candidate for Opus Stream
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245] - Server Reflexive ICE Candidate for the above host candidate
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245] - Second Host Candidate
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245] - Server Reflexive Candidate for the Second Host Candidate
a=rtcp-fb:99 nack	[RFC5104] - Indicates support for NACK based RTCP feedback
a=rtcp-fb:99 nack pli	[RFC5104] - Indicates support for Picture loss Indication and NACK
a=rtcp-fb:99 ccm fir	[RFC5104] - Full Intra Frame Request-Codec Control Message support
a=ssrc:3229706345 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=rtcp-rsize	[RFC5506] - Bob intends to use reduced size RTCP for this session

a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]

Table 4: 5.2.2 SDP Answer

5.2.3. Two-Way Data Only Session

This scenario illustrates SDP negotiated to setup a data-only session based on SCTP Data Channel, thus enabling use-cases such as file-transfer for example.

title WebRTC Session - 2-Way Secure Audio,Video with RTCP Feedback
Alice->Bob: Offer(DataChannel)
Bob->Alice: Answer(Data-Channel)
Alice->Bob: Two-way SCTP based Data-Channel

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE data	[draft-ietf-mmusic-sdp-bundle-negotiation]
a=ice-ufrag:074c6550	[RFC5245] - Session Level ICE parameter
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245] - Session Level ICE parameter
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245] - Session DTLS Fingerprint for SRTP
m=application 56966 DTLS/SCTP 5000	[draft-ietf-rtcweb-data-channel]
c=IN IP4 24.23.204.141	[RFC4566]
a=mid:data	[RFC5888]
a=sctpmap:5000 webrtc-Datachannel 1	[draft-ietf-mmusic-sctp-sd

		p] - One data stream of type chat
a=webrtc-Datachannel:5000 stream=1;label="channel 1";subprotocol="chat"; a=setup:actpass		[draft-ietf-mmusic-sctp-sdp]
		[RFC4145] - Alice can perform DTLS before Answer arrives

a=sendrecv		[RFC3264] - Alice can send and recv non-media data
a=candidate:0 1 UDP 2113667327 192.168.1.7 56966 typ host		[RFC5245]
a=candidate:1 1 UDP 1694302207 24.23.204.141 56966 typ srflx raddr 192.168.1.7 rport 56966		[RFC5245]
a=ice-options:trickle		[draft-ivov-mmusic-trickle-ice]

Table 5: 5.2.3 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE data	[draft-ietf-mmusic-sdp-bundle-negotiation]
m=application 55700 DTLS/SCTP 5000	[draft-ietf-mmusic-sctp-sdp]
c=IN IP4 98.248.92.771	[RFC4566]
a=mid:data	[RFC5888]
a=sctpmap:5000 webrtc-Datachannel 1	[draft-ietf-mmusic-sctp-sdp]
a=webrtc-Datachannel:5000 stream=1;label="channel 1";subprotocol="chat";	[draft-ietf-mmusic-sctp-sdp]

a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=sendrecv	[RFC3264] - Bob can send and recv non-media data
a=ice-ufrag:c300d85b	[RFC5245] - Session Level ICE username frag
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245] - Session Level ICE password
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245] - Session DTLS Fingerprint for SRTP
a=candidate:0 1 UDP 2113667327 192.168.1.7 55700 typ host	[RFC5245] - Refer 4.1 SDP Offer

a=candidate:1 1 UDP 1694302207 98.248.92.77 55700 typ srflx raddr 192.168.1.7 rport 55700	[RFC5245] Refer 4.1 SDP Offer
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]

Table 6: 5.2.3 SDP Answer

5.2.4. Audio Call On Hold

Alice calls Bob, but when Bob answers he places Alice on hold by setting the SDP direction attribute to a=sendonly in the Answer.

```
title Secure 2-Way Audio Only Session
participant Alice as Alice
participant Bob as Bob
Alice->Bob: Offer(Audio:Opus)
Bob->Alice: Answer(Audio:Opus,a=sendonly)
Alice->Bob: One-way Opus Audio (preferred codec)
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio	[draft-ietf-mmusic-sdp-bundle-negotiation]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=mid:audio	[RFC5888]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605] - Port for RTCP

	data
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus] - Opus Codec 48khz, 2 channels
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus] - Opus packetization of20ms
a=sendrecv	[RFC3264] - Alice can send and recv audio
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761] - Alice can perform RTP/RTCP Muxing on port 54609
a=ice-ufrag:074c6550	[RFC5245] - ICE user fragment
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245] - ICE password
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245] - DTLS Fingerprint for SRTP
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]

a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]
a=rtcp-fb:109 nack	[RFC5104] - Indicates NACK RTCP feedback support
a=ssrc:3229706345 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]

| a=rtcp-rsize | [RFC5506] |
| a=ice-options:trickle | [draft-ivov-mmusic-trickle-ice] |

Table 7: 5.2.4 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin

		Information
s=-		[RFC4566]
t=0 0		[RFC4566]
a=msid-semantic:WMS		[MSID]
a=group:BUNDLE audio		[draft-ietf-mmusic-sdp-bundle-negotiation]
m=audio 49203 UDP/TLS/RTP/SAVPF 109		[RFC4566]
a=mid:audio		[RFC5888]
a=msid:ma ta		Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77		[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77		[RFC3605] - Port for RTCP data
a=rtpmap:109 opus/48000/2		[draft-ietf-payload-rtp-opus] - Bob accepts only OpusCodec
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level		[RFC6464]
a=ptime:20		[draft-ietf-payload-rtp-opus]
a=sendonly		[RFC3264] - Bob puts call On Hold
a=setup:active		[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux		[RFC5761] - Bob can perform RTP/RTCP Muxing on port 49203
a=ice-ufrag:c300d85b		[RFC5245] - ICE username frag
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2		[RFC5245] - ICE password
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07		[RFC5245] - DTLS Fingerprint for SRTP
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host		[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203		[RFC5245]

a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=ssrc:1366781083 cname:EocUG1f0fcg/yvY7	[RFC5576]
a=rtcp-rsize	[RFC5506]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]

Table 8: 5.2.4 SDP Answer

5.2.5. Audio with DTMF Session

In this example, Alice wishes to establish two separate audio streams, one for normal audio and the other for telephone-events. Alice offers first audio stream with three codecs and the other with [RFC2833] tones (for DTMF). Bob accepts both the audio streams by choosing Opus as the audio codec and the telephone-event for the other stream.

```
title Audio Session with DTMF
participant Alice as Alice
participant Bob as Bob
Alice->Bob: Offer(Audio:Opus,PCMU,PCMA Audio:telephone-event)
Bob->Alice: Answer(Audio:Opus, Audio:telephone-event)
Alice->Bob: Opus audio stream and telephone-event stream
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio dtmf	[draft-ietf-mmusic-sdp-bundle-negotiation]
m=audio 54609 UDP/TLS/RTP/SAVPF 109 0 8	[RFC4566]
a=mid:audio	[RFC5888]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)

c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605] - Port for RTCP data
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus] - Opus Codec 48khz, 2 channels
a=ptime:20	[draft-ietf-payload-rtp-opus] - Opus packetization of20ms
a=rtpmap:0 PCMU/8000	[RFC3551] PCMU Audio Codec
a=rtpmap:8 PCMA/8000	[RFC3551] PCMA Audio Codec
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=sendrecv	[RFC3264] - Alice can send and recv audio
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761] - Alice can perform RTP/RTCP Muxing on port 54609
a=ice-ufrag:074c6550	[RFC5245] - ICE user fragment
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245] - ICE password parameter
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245] - DTLS Fingerprint for SRTP
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]
a=rtcp-fb:109 nack	[RFC5104] - Indicates NACK RTCP feedback support
a=ssrc:3229706345	[RFC5576]

cname:Q/NWs1ao1HmN4Xa5		
a=rtcp-rsize	[RFC5506]	
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]	
m=audio 54609 UDP/TLS/RTP/SAVPF 126	[RFC4566]	
a=mid:dtmf	[RFC5888]	

a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)	
c=IN IP4 24.23.204.141	[RFC4566]	
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605] - Port for RTCP data	
a=rtpmap:126 telephone-event/8000	[RFC2833]	
a=sendonly	[RFC3264] - Alice can send DTMF Events	
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives	
a=rtcp-mux	[RFC5761]	
a=ice-ufrag:074c6550	[RFC5245] - ICE user fragment	
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245] - ICE password parameter	
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245] - DTLS Fingerprint for SRTP	
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]	
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]	
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]	
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]	
a=rtcp-fb:109 nack	[RFC5104] - Indicates NACK RTCP feedback support	
a=ssrc:9032206345 cname:L/N9lk1ao1HmN4Xa5	[RFC5576]	

a=rtcp-rsize	[RFC5506]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]

Table 9: 5.2.5 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information

s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio dtmf	[draft-ietf-mmusic-sdp-bundle-negotiation]
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=mid:audio	[RFC5888]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605] - Port for RTCP data
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus] - Bob accepts Opus Codec
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=sendrecv	[RFC3264] - Bob can send and receive Opus audio
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761] - Bob can

		perform RTP/RTCP Muxing on port 49203
a=ice-ufrag:c300d85b		[RFC5245] - ICE username frag
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2		[RFC5245] - ICE password
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07		[RFC5245] - Fingerprint for SRTP
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host		[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203		[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host		[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065		[RFC5245]

a=ssrc:0634322975 cname:Q/o1HmN4XNWs1aa5		[RFC5576]
a=rtcp-rsize		[RFC5506] - Alice intends to use reduced size RTCP for this session
a=ice-options:trickle		[draft-ivov-mmusic-trickle-ice]
m=audio 49203 UDP/TLS/RTP/SAVPF 126		[RFC4566]
a=mid:dtmf		[RFC5888]
a=msid:ma tb		Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 98.248.92.77		[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77		[RFC3605] - Port for RTCP data
a=rtpmap:126 telephone-event/8000		[RFC2833]
a=recvonly		[RFC3264] - Alice can receive DTMF events
a=setup:active		[RFC4145] - Bob carries out DTLS Handshake in

a=rtcp-mux	[RFC5761] - Alice can perform RTP/RTCP Muxing on port 54690
a=ice-ufrag:c300d85b	[RFC5245] - ICE username frag
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245] - ICE password
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245] - Fingerprint for SRTP
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=ssrc:6345903220 cname:L/k1aN9lo1HmN4Xa5	[RFC5576]
a=rtcp-rsize	[RFC5506] - Alice intends to use reduced size RTCP for this session

a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]

Table 10: 5.2.5 SDP Answer

5.2.6. One Way Audio/Video Session - Document Camera

In this scenario Alice and Bob engage in 1 way audio and video session with Bob receiving Alice's audio and her presentation slides as video stream.

title 1 Way Audio & Video Session - Document Camera

```
   note right of Alice
   Alice Offers sendonly audio and video streams.
   The video stream corresponds to her presentation
   slides via a=content SDP attribute)
   end note
   Alice->Bob: Offer(Audio:Opus, Video: VP8)
   note left of Bob
   Bob accepts Alice's offer
   end note
   Bob->Alice: Answer(Audio:Opus, Video: VP8)
   Alice->Bob: One-way Opus Audio, VP8 Video
   note right of Alice
   Bob can hear Alice and see her presentation slides.
   end note
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20519 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video	[draft-ietf-mmusic-sdp-bundle-negotiation]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=mid:audio	[RFC5888]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605] - Port for RTCP data

a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]

a=sendonly	[RFC3264] - Send only audio stream
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 24.23.204.141 54609 typ host	[RFC5245]
a=candidate:0 2 UDP 2113667326 24.23.204.141 64678 typ host	[RFC5104]
a=rtcp-fb:109 nack	[RFC5104]
a=ssrc:6345903220 cname:L/k1aN9lo1HmN4Xa5	[RFC5576]
a=rtcp-rsize	[RFC5506]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=video 54609 UDP/TLS/RTP/SAVPF 120	[RFC4566]
a=mid:video	[RFC5888]
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605] - Port for RTCP data
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]
a=content:slides	[RFC4796] -Alice's presentation video stream
a=sendonly	[RFC3264] - Send only video stream
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761]
a=ice-ufrag:074c6550	[RFC5245]

a=ice-pwd:a28a397a4c3f31747d1ee3474a f08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 24.23.204.141 54609 typ host	[RFC5245]
a=candidate:0 2 UDP 2113667326 24.23.204.141 64678 typ host	[RFC5104]
a=rtcp-fb:120 nack	[RFC5104]
a=rtcp-fb:120 nack pli	[RFC5104]
a=rtcp-fb:120 ccm fir	[RFC5104]
a=ssrc:3429951804 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=rtcp-rsize	[RFC5506]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]

Table 11: 5.2.6 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video	[draft-ietf-mmusic-sdp-bundle-negotiation]
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=mid:audio	[RFC5888]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605] - Port for RTCP data
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]

a=recvonly	[RFC3264] - Receive only audio stream
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 98.248.92.77 49203 typ host	[RFC5245]
a=candidate:0 2 UDP 2113667326 98.248.92.77 60065 typ host	[RFC5245]
a=ssrc:9513429804 cname:Q/o1HmNWs1aN4Xa5	[RFC5576]
a=rtcp-rsize	[RFC5506]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=video 49203 UDP/TLS/RTP/SAVPF 120	[RFC4566]
a=mid:video	[RFC5888]
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605] - Port for RTCP data
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]
a=content:slides	[RFC4796]
a=recvonly	[RFC3264] - Receive Only Alice's presentation stream
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]
a=fingerprint:sha-1	[RFC5245]

99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:		
c7:70:9d:1f:66:79:a8:07		
a=candidate:0 1 UDP 2113667327	[RFC5245]	
98.248.92.77 49203 typ host		

a=candidate:0 2 UDP 2113667326	[RFC5245]	
98.248.92.77 60065 typ host		
a=ssrc:1366781083	[RFC5576]	
cname:EocUG1f0fcg/yvY7		
a=rtcp-rsize	[RFC5506]	
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]	

Table 12: 5.2.6 SDP Answer

5.2.7. Audio, Video Session with BUNDLE Support Unknown

In this example, since Alice is unsure of the Bob's support of the BUNDLE framework, following 3 step procedures are performed in order to negotiate and setup a unique BUNDLE Address for the session

- An SDP Offer, in which the Alice assigns unique addresses to each "m=" line in the BUNDLE group, and requests the Answerer to select the Offerer's BUNDLE address.
- An SDP Answer, in which the Bob indicates its support for BUNDLE, and assigns its own BUNDLE address for the BUNDLED m= lines.
- A subsequent SDP Offer from Alice, which is used to perform a BUNDLE Address Synchronization (BAS).

Once the Offer/Answer exchange completes, both Alice and Bob each end up using single RTP Session for both the Media Streams.

```
title 2-Way Secure Audio,Video with BUNDLE support unknown

Alice->Bob: Offer(Audio:Opus Video:VP8)
note right of Alice
Alice offers BUNDLE support with unique address for the audio and video m-line
end note

Bob->Alice: Answer(Audio:Opus Video:VP8) indicating its support for BUNDLE
note left of Bob
Bob uses identical addresses across the m=lines
```

end note

Alice->Bob: Updated Offer(Audio:Opus Video:VP8) for Bundle Address Synchronzati

Alice <-> Bob: 2Way Call with Audio and Video Multiplexed

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]

t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=mid:audio	[RFC5888] Audio m=line part of BUNDLE group with a unique port number
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761]

a=ssrc:11111 cname:EocUG1f0fcg/yvY7	[RFC5576]	
a=ice-ufrag:074c6550	[RFC5245]	
a=ice-pwd:a28a397a4c3f31747d1ee3474a f08a068	[RFC5245]	
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07	[RFC5245]	
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]	
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]	
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]	
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]	
a=rtcp-fb:109 nack	[RFC5104]	
a=rtcp-rsize	[RFC5506]	

a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=video 62537 UDP/TLS/RTP/SAVPF 120	[RFC4566]
a=mid:video	[RFC5888] Video m=line part of the Bundle group with a unique port number
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:54721 IN IP4 24.23.204.141	[RFC3605] - Port for RTCP data
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761]
a=ssrc:22222 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=ice-ufrag:6550074c	[RFC5245]
a=ice-pwd:74af08a068a28a397a4c3f3174	[RFC5245]

7d1ee34	
a=fingerprint:sha-1 1f:ef:6d:f7:c9:c7:70:9d:1f:66:99:41: 49:83:4a:97:0e79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 62537 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 24.23.204.141 62537 typ srflx raddr 192.168.1.4 rport 62537	[RFC5245]
a=candidate:0 2 2113667326 192.168.1.4 54721 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 54721 typ srflx raddr 192.168.1.4 rport 54721	[RFC5245]
a=rtcp-fb:120 nack	[RFC5104]
a=rtcp-fb:120 nack pli	[RFC5104]
a=rtcp-fb:120 ccm fir	[RFC5104]
a=rtcp-rsize	[RFC5506]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]

Table 13: 5.2.7 SDP Offer w/BUNDLE

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video	[draft-ietf-mmusic-sdp-bundle-negotiation] Bob supports BUNDLE semantics.
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and

	RTCMediaStreamTrack ID (ta)
a=mid:audio	[RFC5888] Audio m=line part of the BUNDLE group
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605] - Port for RTCP data
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=sendrecv	[RFC3264]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-fb:109 nack	[RFC5104]
a=rtcp-mux	[RFC5761]
a=ssrc:33333 cname:Q/1HmN4Xa5NWs1ao	[RFC5576]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]

a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=rtcp-rsize	[RFC5506]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]

m=video 49203 UDP/TLS/RTP/SAVPF 120	[RFC4566]	
a=mid:video	[RFC5888] Video m=line part of the BUNDLE group with the port from audio line repeated	
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)	
c=IN IP4 98.248.92.77	[RFC4566]	
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605] - Port for RTCP data	
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]	
a=sendrecv	[RFC3264]	
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel	
a=rtcp-mux	[RFC5761]	
a=ssrc:44444 cname:Q/2AqlmN4Xa5NWs	[RFC5576]	
a=ice-ufrag:85bc300d	[RFC5245]	
a=ice-pwd:bd2de4e9991c325921d5d47efb abd9a2	[RFC5245]	
a=fingerprint:sha-1 41:49:83:4a:99:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07	[RFC5245]	
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245] - Candidate lines identical with the audio m-line.	
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]	
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]	
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]	
a=rtcp-fb:120 nack	[RFC5104]	
a=rtcp-fb:120 nack pli	[RFC5104]	
a=rtcp-fb:120 ccm fir	[RFC5104]	
a=rtcp-rsize	[RFC5506]	

a=ice-options:trickle	[draft-ivov-mmusic-trickle	

	-ice]

Table 14: 5.2.7 SDP Answer w/BUNDLE

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video	[draft-ietf-mmusic-sdp-bundle-negotiation]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
a=mid:audio	[RFC5888] - Port number finalized as Bundle Address.
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761]
a=ssrc:11111 cname:EocUG1f0fcg/yvY7	[RFC5576]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]

a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]
a=rtcp-fb:109 nack	[RFC5104]
a=rtcp-rsize	[RFC5506]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=video 54609 UDP/TLS/RTP/SAVPF 120	[RFC4566]
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
a=mid:video	[RFC5888] - Same Bundle address from the audio m=line
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761]
a=ssrc:22222 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]
a=rtcp-fb:120 nack	[RFC5104]

| a=rtcp-fb:120 nack pli | [RFC5104] |
| a=rtcp-fb:120 ccm fir | [RFC5104] |

| a=rtcp-rsize | [RFC5506] |
| a=ice-options:trickle | [draft-ivov-mmusic-trickle-ice] |

Table 15: 5.2.7 SDP Offer for BAS

5.2.8. Audio, Video and Data Session

This example show-cases SDP for negotiating a session with Audio, Video and data streams between Alice and Bob with [draft-ietf-mmusic-sdp-bundle-negotiation] support known

```
title Audio, Video, Data with BUNDLE support known

Alice->Bob: Offer(Audio:Opus, Video:VP8, Data)
note right of Alice
Alice indicates BUNDLE support with identical address across all the m=lines.
end note

Bob->Alice: Answer(Audio:Opus Video:VP8, Data)
note left of Bob
Bob does the same
end note
Alice<->Bob: Two way Audio, Video and Data multiplexed
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video data	[draft-ietf-mmusic-sdp-bundle-negotiation]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and

		RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141		[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141		[RFC3605]
a=mid:audio		[RFC5888]
a=rtpmap:109 opus/48000/2		[draft-ietf-payload-rtp-opus]

a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level		[RFC6464]
a=ptime:20		[draft-ietf-payload-rtp-opus]
a=sendrecv		[RFC3264]
a=setup:actpass		[RFC4145]
a=rtcp-mux		[RFC5761]
a=ice-ufrag:074c6550		[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068		[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07		[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host		[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609		[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host		[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678		[RFC5245]
a=rtcp-fb:109 nack		[RFC5104]
a=ssrc:11111 cname:Q/NWs1ao1HmN4Xa5		[RFC5576]
a=rtcp-rsize		[RFC5506]
a=ice-options:trickle		[draft-ivov-mmusic-trickle-ice]
m=video 54609 UDP/TLS/RTP/SAVPF 120		[RFC4566]
a=msid:ma tb		Identifies RTCMediaStream ID (ma) and

		RTCMediaStreamTrack ID (tb)
c=IN IP4 24.23.204.141	[RFC4566]	
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]	
a=mid:video	[RFC5888]	
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]	
a=sendrecv	[RFC3264]	
a=setup:actpass	[RFC4145]	
a=rtcp-mux	[RFC5761]	
a=ice-ufrag:074c6550	[RFC5245]	
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]	
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]	

a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]	
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]	
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]	
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]	
a=rtcp-fb:120 nack	[RFC5104]	
a=rtcp-fb:120 nack pli	[RFC5104]	
a=rtcp-fb:120 ccm fir	[RFC5104]	
a=ssrc:22222 cname:Q/aoNWs11HmN4Xa5	[RFC5576]	
a=rtcp-rsize	[RFC5506]	
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]	
m=application 54609 DTLS/SCTP 5000	[draft-ietf-rtcweb-data-channel]	
c=IN IP4 24.23.204.141	[RFC4566]	
a=mid:data	[RFC5888]	
a=sctpmap:5000 webrtc-Datachannel 1	[draft-ietf-mmusic-sctp-sdp]	
a=webrtc-Datachannel:5000 stream=1;label="channel	[draft-ietf-mmusic-sctp-sdp]	

1";subprotocol="chat";	
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]

Table 16: 5.2.8 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video data	[draft-ietf-mmusic-sdp-bundle-negotiation]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice] Bob's trickle support is indicated at the session level
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and

		RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77		[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77		[RFC3605]
a=mid:audio		[RFC5888]
a=rtpmap:109 opus/48000/2		[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level		[RFC6464]
a=ptime:20		[draft-ietf-payload-rtp-opus]
a=sendrecv		[RFC3264]
a=setup:active		[RFC4145]
a=rtcp-mux		[RFC5761]
a=rtcp-fb:109 nack		[RFC5104]
a=ice-ufrag:c300d85b		[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2		[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07		[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host		[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203		[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host		[RFC5245]

a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065		[RFC5245]
a=ssrc:33333 cname:L/aoNWs11HmN4Xa5		[RFC5576]
a=rtcp-rsize		[RFC5506]
m=video 49203 UDP/TLS/RTP/SAVPF 120		[RFC4566]
a=msid:ma tb		Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 98.248.92.77		[RFC4566]

a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:video	[RFC5888]
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]
a=sendrecv	[RFC3264]
a=setup:active	[RFC4145]
a=rtcp-mux	[RFC5761]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efb abd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=rtcp-fb:120 nack	[RFC5104]
a=rtcp-fb:120 nack pli	[RFC5104]
a=rtcp-fb:120 ccm fir	[RFC5104]
a=ssrc:44444 cname:EocUG1f0fcg/yvY7	[RFC5576]
a=rtcp-rsize	[RFC5506]
m=application 49203 DTLS/SCTP 5000	[draft-ietf-mmusic-sctp-sdp]
c=IN IP4 98.248.92.771	[RFC4566]
a=mid:data	[RFC5888]
a=sctpmap:5000 webrtc-Datachannel 1	[draft-ietf-mmusic-sctp-sdp]
a=webrtc-Datachannel:5000 stream=1;label="channel 1";subprotocol="chat";	[draft-ietf-mmusic-sctp-sdp]
a=setup:active	[RFC4145]

a=sendrecv	[RFC3264]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efb abd9a2	[RFC5245]

a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]

Table 17: 5.2.8 SDP Answer

5.2.9. Two-Way Audio,Video w/BUNDLE Unsupported

This use-case illustrates SDP Offer/Answer exchange when the far-end (Bob) either doesn't support media bundling or doesn't want to group m=lines over a single 5-tuple.

On successful Offer/Answer exchange, Alice and Bob each end up using unique 5-tuple for audio and video media streams respectively.

```
title 2-Way Secure Audio,Video with BUNDLE Unsupported

Alice->Bob: Offer(Audio:Opus Video:VP8)
note right of Alice
Alice offers BUNDLE support with unique address for the audio and video m-line
end note

Bob->Alice: Answer(Audio:Opus Video:VP8)
note left of Bob
Bob uses unique addresses as well since he doesn't understand BUNDLE
end note

Alice <-> Bob: 2Way Call with Audio and Video on different addresses.
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]

a=group:BUNDLE audio video	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 55232 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
a=mid:audio	[RFC5888] Audio m=line part of BUNDLE group with a unique port number
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=sendrecv	[RFC3264]
a=rtcp-mux	[RFC5761]
a=rtcp-fb:109 nack	[RFC5104]
a=ssrc:11111 cname:EocUG1f0fcg/yvY7	[RFC5576]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 55232 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 55232 typ srflx raddr 192.168.1.4 rport 55232	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]

| a=rtcp-rsize | [RFC5506] |

m=video 54332 UDP/TLS/RTP/SAVPF 120	[RFC4566]
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
a=mid:video	[RFC5888] Video m=line part of the BUNDLE group with a unique port number
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:54721 IN IP4 24.23.204.141	[RFC3605]
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761]
a=ssrc:22222 cname:yvY7/EocUG1f0fcg	[RFC5576]
a=ice-ufrag:7872093	[RFC5245]
a=ice-pwd:ee3474af08a068a28a397a4c3f31747d1	[RFC5245]
a=fingerprint:sha-1 6d:f7:c9:c7:70:9d:1f:66:79:a8:07:99:41:49:83:4a:97:0e:1f:ef	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54332 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 24.23.204.141 54332 typ srflx raddr 192.168.1.4 rport 54332	[RFC5245]
a=candidate:0 2 2113667326 192.168.1.4 54721 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 54721 typ srflx raddr 192.168.1.4 rport 54721	[RFC5245]
a=rtcp-fb:120 nack	[RFC5104]
a=rtcp-fb:120 nack pli	[RFC5104]
a=rtcp-fb:120 ccm fir	[RFC5104]
a=rtcp-rsize	[RFC5506]

Table 18: 5.2.9 SDP Offer w/BUNDLE

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 53214 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=sendrecv	[RFC3264]
a=rtcp-fb:109 nack	[RFC5104]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]

a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:7 0:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 53214 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 53214 typ srflx raddr 192.168.1.7 rport 53214	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=rtcp-rsize	[RFC5506]
m=video 58679 UDP/TLS/RTP/SAVPF 120	[RFC4566]

a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:56507 IN IP4 98.248.92.77	[RFC3605]
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=sendrecv	[RFC3264]
a=ice-ufrag:85bC300	[RFC5245]
a=ice-pwd:325921d5d47efbabd9a2de4e99bd291c	[RFC5245]
a=fingerprint:sha-1 9d:1f:66:79:a8:07:99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 58679 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 58679 typ srflx raddr 192.168.1.7 rport 58679	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 56607 typ host	[RFC5245]

a=candidate:1 2 UDP 1694302206 98.248.92.77 56607 typ srflx raddr 192.168.1.7 rport 56607	[RFC5245]	
a=rtcp-fb:120 nack	[RFC5104]	
a=rtcp-fb:120 nack pli	[RFC5104]	
a=rtcp-fb:120 ccm fir	[RFC5104]	
a=rtcp-rsize	[RFC5506]	

Table 19: 5.2.9 SDP Answer without BUNDLE

5.2.10. Audio, Video BUNDLED but Data Not BUNDLED

This example show-cases SDP for negotiating a session with Audio, Video and data streams between Alice and Bob but with data stream not part of the BUNDLE group. This is shown by assigning unique port for data media sections.


```
title Audio, Video, with Data out of BUNDLE
Alice->Bob: Offer(Audio:Opus, Video:VP8, Data (Not in BUNDLE)
note right of Alice
Alice wants to multiplex audio, video but not data
end note

Bob->Alice: Answer(Audio:Opus Video:VP8, Data)
note left of Bob
Bob does the same
end note
Alice<->Bob: Two way Audio, Video multiplexed except Data
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]

a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice wants to BUNDLE only audioand video media.
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:audio	[RFC5888]
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145]
a=rtcp-mux	[RFC5761]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]

a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr	[RFC5245]

192.168.1.4 rport 64678	
a=rtcp-fb:109 nack	[RFC5104]
a=ssrc:11111 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=rtcp-rsize	[RFC5506]
m=video 54609 UDP/TLS/RTP/SAVPF 120	[RFC4566]
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:video	[RFC5888]
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145]
a=rtcp-mux	[RFC5761]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474a f08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]
a=rtcp-fb:120 nack	[RFC5104]
a=rtcp-fb:120 nack pli	[RFC5104]
a=rtcp-fb:120 ccm fir	[RFC5104]
a=ssrc:22222 cname:Q/aoNWs11HmN4Xa5	[RFC5576]

a=rtcp-rsize	[RFC5506]
m=application 10000 DTLS/SCTP 5000	[draft-ietf-rtcweb-data-channel]
c=IN IP4 24.23.204.141	[RFC4566]
a=mid:data	[RFC5888]

a=sctpmap:5000 webrtc-Datachannel 1	[draft-ietf-mmusic-sctp-sdp]
a=webrtc-Datachannel:5000 stream=1;label="channel 1";subprotocol="chat";	[draft-ietf-mmusic-sctp-sdp]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145]
a=ice-ufrag:89819013	[RFC5245]
a=ice-pwd:1747d1ee3474af08a068a28a397a4c3f3	[RFC5245]
a=fingerprint:sha-1 0e:1f:ef:6d:f7:c9:c7:70:99:41:49:83:4a:97:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 10000 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 10000 typ srflx raddr 192.168.1.4 rport 10000	[RFC5245]

Table 20: 5.2.10 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video	[draft-ietf-mmusic-sdp-bundle-negotiation]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:audio	[RFC5888]

a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=sendrecv	[RFC3264]
a=setup:active	[RFC4145]
a=rtcp-mux	[RFC5761]
a=rtcp-fb:109 nack	[RFC5104]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=ssrc:33333 cname:L/aoNWs11HmN4Xa5	[RFC5576]
a=rtcp-rsize	[RFC5506]
m=video 49203 UDP/TLS/RTP/SAVPF 120	[RFC4566]
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 98.248.92.771	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:video	[RFC5888]
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]
a=sendrecv	[RFC3264]
a=setup:active	[RFC4145]
a=rtcp-mux	[RFC5761]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]

a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=rtcp-fb:120 nack	[RFC5104]
a=rtcp-fb:120 nack pli	[RFC5104]
a=rtcp-fb:120 ccm fir	[RFC5104]
a=ssrc:44444 cname:EocUG1f0fcg/yvY7	[RFC5576]
a=rtcp-rsize	[RFC5506]
m=application 20000 DTLS/SCTP 5000	[draft-ietf-mmusic-sctp-sdp]
c=IN IP4 98.248.92.77	[RFC4566]
a=mid:data	[RFC5888]
a=sctpmap:5000 webrtc-Datachannel 1	[draft-ietf-mmusic-sctp-sdp]
a=webrtc-Datachannel:5000 stream=1;label="channel 1";subprotocol="chat";	[draft-ietf-mmusic-sctp-sdp]
a=setup:active	[RFC4145]
a=sendrecv	[RFC3264]
a=ice-ufrag:991Ca2a5e	[RFC5245]
a=ice-pwd:921d5d47efbabd9a2de4e99bd291c325	[RFC5245] - Session Level ICE password
a=fingerprint:sha-1 6d:f7:c9:c7:70:9d:1f:66:79:a8:07:99:41:49:83:4a:97:0e:1f:ef	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 20000 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 20000 typ srflx raddr 192.168.1.7 rport 20000	[RFC5245]

Table 21: 5.2.10 SDP Answer

5.2.11. Audio Only then Add Video and BUNDLE

This example involves 2 Offer/Answer exchanges. First one setting up Audio-only session followed by an updated Offer/Answer exchange to add video stream to the ongoing session. Also the newly added video stream is BUNDLED with the audio stream.


```
title Audio Only , Add Video and BUNDLE

Alice->Bob: Offer(Audio:Opus)
note right of Alice
Alice indicates support for BUNDLE
end note

Bob->Alice: Answer(Audio:Opus)
note left of Bob
Bob also indicates support for BUNDLE
end note
Alice<->Bob: Two way Audio only session

Alice->Bob: Updated Offer(Audio:Opus, Video:VP8)
note right of Alice
Alice adds video stream to BUNDLE with audio
end note

Bob->Alice: Updated Answer(Audio:Opus, Video:VP8)
note left of Bob
Bob also does the same
end note
Alice<->Bob: Two way Opus Audio and VP8 Video session
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice wants to BUNDLE only audioand video media.
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:audio	[RFC5888]
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-op

		us]
a=sendrecv		[RFC3264]
a=setup:actpass		[RFC4145]
a=rtcp-mux		[RFC5761]
a=ice-ufrag:074c6550		[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474a f08a068		[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07		[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host		[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609		[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host		[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678		[RFC5245]

a=rtcp-fb:109 nack	[RFC5104]
a=ssrc:11111 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=rtcp-rsize	[RFC5506]

Table 22: 5.2.11 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio	[draft-ietf-mmusic-sdp-bundle-negotiation]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]

a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:audio	[RFC5888]
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=sendrecv	[RFC3264]
a=setup:active	[RFC4145]
a=rtcp-mux	[RFC5761]
a=rtcp-fb:109 nack	[RFC5104]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]

a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=ssrc:33333 cname:L/aoNWs11HmN4Xa5	[RFC5576]
a=rtcp-rsize	[RFC5506]

Table 23: 5.2.10 SDP Answer

SDP Contents	RFC#/Notes
v=1	Version number incremented [RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice wants to BUNDLE only audioand video media.
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:audio	[RFC5888]
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145]
a=rtcp-mux	[RFC5761]
a=ice-ufrag:074c6550	[RFC5245]

a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]

a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]
a=rtcp-fb:109 nack	[RFC5104]
a=ssrc:11111 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=rtcp-rsize	[RFC5506]
m=video 54609 UDP/TLS/RTP/SAVPF 120	[RFC4566]
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:video	[RFC5888]
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145]
a=rtcp-mux	[RFC5761]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]
a=rtcp-fb:120 nack	[RFC5104]
a=rtcp-fb:120 nack pli	[RFC5104]

a=rtcp-fb:120 ccm fir	[RFC5104]
a=ssrc:22222 cname:Q/aoNWs11HmN4Xa5	[RFC5576]
a=rtcp-rsize	[RFC5506]

Table 24: 5.2.11 SDP Updated Offer

SDP Contents	RFC#/Notes
v=1	[RFC4566] Version number incremented
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio video	[draft-ietf-mmusic-sdp-bundle-negotiation]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:audio	[RFC5888]
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=sendrecv	[RFC3264]
a=setup:active	[RFC4145]
a=rtcp-mux	[RFC5761]
a=rtcp-fb:109 nack	[RFC5104]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]

a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=ssrc:33333 cname:L/aoNWs11HmN4Xa5	[RFC5576]
a=rtcp-rsize	[RFC5506]
m=video 49203 UDP/TLS/RTP/SAVPF 120	[RFC4566]
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:video	[RFC5888]
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]
a=sendrecv	[RFC3264]
a=setup:active	[RFC4145]
a=rtcp-mux	[RFC5761]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efb abd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=rtcp-fb:120 nack	[RFC5104]
a=rtcp-fb:120 nack pli	[RFC5104]
a=rtcp-fb:120 ccm fir	[RFC5104]
a=ssrc:44444 cname:EocUG1f0fcg/yvY7	[RFC5576]
a=rtcp-rsize	[RFC5506]

Table 25: 5.2.11 SDP Updated Answer

5.3. MultiResolution, RTX, FEC Examples

This section deals with scenarios related to multiresolution negotiation such as layered coding, simulcast, along with techniques that deal with providing robustness against transmission errors such as FEC and RTX. Also to note, meachnisms such as FEC and RTX could be envisioned in the above basic scenarios as well.

5.3.1. Sendonly Simulcast w/2 cameras and 2 encodings per camera

This SDP below shows Offer/Answer exchange with an audio and two video streams each of which can be sent at two different resolutions.

One video stream supports VP8, while the other supports H.264.

bundle-only framework is used along with BUNDLE grouping framework to enable multiplexing of all the 5 streams (1 audio stream + 4 video streams) over a single RTP Session.

```
title 1 Way Successful Simulcast w/BUNDLE

note right of Alice
Alice offers 2 sendonly video streams with 2 simulcast encodings per stream
end note
Alice->Bob: Offer(Audio:Opus,Video1:VP8,Video2:H.264) with bundle-only for vide
note left of Bob
Bob accepts Alice's offer and 2 encodings per stream
end note
Alice->Bob: One-Way 1 Opus, 2 H.264 and 2 VP8 video streams, all mulitplexed
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20519 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]

t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE m0 m1 m2	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]

a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:m0	[RFC5888] Audio m=line part of BUNDLE group with a unique port number
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=sendonly	[RFC3264]
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761]
a=rtcp-fb:109 nack	[RFC5104]
a=ssrc:11111 EocUG1f0fcg	[RFC5576]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]

a=candidate:0 1 UDP 2113667327	[RFC5245]
192.168.1.4 54609 typ host	
a=candidate:1 1 UDP 694302207	[RFC5245]
24.23.204.141 54609 typ srflx raddr	
192.168.1.4 rport 54609	
a=candidate:0 2 UDP 2113667326	[RFC5245]
192.168.1.4 64678 typ host	
a=candidate:1 2 UDP 1694302206	[RFC5245]
24.23.204.141 64678 typ srflx raddr	
192.168.1.4 rport 64678	
a=rtcp-rsize	[RFC5506]
m=video 0 UDP/TLS/RTP/SAVPF 98 100	bundle-only video line with port number set to zero
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 24.23.204.141	[RFC4566]

a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:m1	[RFC5888] Video m=line part of BUNDLE group
a=rtpmap:98 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:100 VP8/90000	[draft-ietf-payload-vp8]
a=imageattr:98 [x=1280,y=720]	[RFC6236]Camera-1,Encoding-1 Resolution
a=fmtp:98 max-fr=30	[RFC4566]
a=imageattr:100 [x=640,y=480]	[RFC6236] Camera-1,Encoding-2 Resolution
a=fmtp:100 max-fr=15	[RFC4566]
a=ssrc-group:SIMULCAST 12345 45678	[RFC5576]
a=ssrc:12345 cname:axzo1278npDlAzM73	[RFC5576] [draft-rescorla-avtcore-6222bis] Camera-1,Encoding-1 SSRC with Session CNAME
a=ssrc:45678 cname:axzo1278npDlAzM73	[RFC5576] [draft-rescorla-avtcore-6222bis] Camera-1,Encoding-2 SSRC with Session CNAME
a=sendonly	[RFC3264] - Send only

	video stream
a=rtcp-mux	[RFC5761]
a=bundle-only	[draft-roach-mmusic-unified-plan]
a=rtcp-fb:98 nack	[RFC5104]
a=rtcp-fb:98 nack pli	[RFC5104]
a=rtcp-fb:98 ccm fir	[RFC5104]
a=rtcp-fb:100 nack	[RFC5104]
a=rtcp-fb:100 nack pli	[RFC5104]
a=rtcp-fb:100 ccm fir	[RFC5104]
a=rtcp-rsize	[RFC5506]
m=video 0 UDP/TLS/RTP/SAVPF 101 102	bundle-only video line with port number set to zero
a=msid:ma tc	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tc)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:m2	[RFC5888] Video m=line part of BUNDLE group
a=rtpmap:101 H264/90000	[RFC3984]
a=rtpmap:102 H264/90000	[RFC3984]

a=fmtp:101 profile-level-id=4d0028;packetization-mode=1;max-fr=30	[RFC3984]Camera-2,Encoding-1 Resolution
a=fmtp:102 profile-level-id=4d0028;packetization-mode=1;max-fr=15	[RFC3984]Camera-1,Encoding-2 Resolution
a=ssrc-group:SIMULCAST 67890 56789	[RFC5576]
a=ssrc:67890 cname:axzo1278npDlAzM73	[RFC5576] [draft-rescorla-avtcore-62bis] Camera-1,Encoding-1 SSRC with Session CNAME
a=ssrc:56789 cname:axzo1278npDlAzM73	[RFC5576] [draft-rescorla-avtcore-62bis] Camera-1,Encoding-2 SSRC with Session CNAME

a=sendonly	[RFC3264] - Send only video stream
a=rtcp-mux	[RFC5761]
a=bundle-only	[draft-roach-mmusic-unified-plan]
a=rtcp-fb:101 nack	[RFC5104]
a=rtcp-fb:101 nack pli	[RFC5104]
a=rtcp-fb:101 ccm fir	[RFC5104]
a=rtcp-fb:102 nack	[RFC5104]
a=rtcp-fb:102 nack pli	[RFC5104]
a=rtcp-fb:102 ccm fir	[RFC5104]
a=rtcp-rsize	[RFC5506]

Table 26: 5.3.1 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20519 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE m0 m1 m2	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
c=IN IP4 98.248.92.77	[RFC4566]

a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:m0	[RFC5888] Audio m=line part of BUNDLE group with a unique port number
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)

a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=rtcp-fb:109 nack	[RFC5104]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=sendonly	[RFC3264]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761]
a=ssrc:22222 cname:y8/C90alEocUG1f0fcg	[RFC5576]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.4 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.4 rport 60065	[RFC5245]
a=rtcp-rsize	[RFC5506]
m=video 49203 UDP/TLS/RTP/SAVPF 98 100	BUNDLE accepted with port repeated from the audio port
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 98.248.92.77	[RFC4566]

a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]

a=mid:m1	[RFC5888] Video m=line part of BUNDLE group
a=rtpmap:98 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:100 VP8/90000	[draft-ietf-payload-vp8]
a=imageattr:98 [x=1280,y=720]	[RFC6236]Camera-1,Encoding -1 Resolution
a=fmtp:98 max-fr=30	[RFC4566]
a=imageattr:100 [x=640,y=480]	[RFC6236] Camera-1,Encoding-2 Resolution
a=fmtp:100 max-fr=15	[RFC4566]
a=recvonly	[RFC3264] - receive only video stream
a=ssrc:54321 cname:axzo1278npDlAzM73	[RFC5576]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efb abd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.4 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.4 rport 60065	[RFC5245]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5576]
a=bundle-only	[draft-roach-mmusic-unified-plan]
a=rtcp-rsize	[RFC5506]
m=video 54609 UDP/TLS/RTP/SAVPF 101 102	BUNDLE accepted with port repeated from the audio port
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:56503 IN IP4 98.248.92.77	[RFC3605]
a=msid:ma tc	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tc)

a=mid:m2	[RFC5888] Video m=line part of BUNDLE group
a=rtpmap:101 H264/90000	[RFC3984]
a=rtpmap:102 H264/90000	[RFC3984]
a=recvonly	[RFC3264] - Send only video stream
a=fmtp:101 profile-level-id=4d0028;packetization-mode=1;max-fr=30	[RFC3984]Camera-2,Encoding-1 Resolution
a=fmtp:102 profile-level-id=4d0028;packetization-mode=1;max-fr=15	[RFC3984]Camera-1,Encoding-2 Resolution
a=ssrc:90876 cname:axzo1278npDlAzM73	[RFC5576]
a=ice-ufrag:ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5576]
a=bundle-only	[draft-roach-mmusic-unified-plan]
a=rtcp-rsize	[RFC5506]

Table 27: 5.3.1 SDP Anwer

5.3.2. Successful SVC Video Stream

This section shows an SDP Offer/Answer for a session with an audio and a single video stream. The video stream is layered coding at 3 different resolutions based on [RFC5583]. The video m=line shows 3 streams with last stream (payload 100) dependent on streams with

payload 96 and 97 for decoding.


```
  title SVC Session - 3 Layers w/BUNDLE
  note right of Alice
  Alice offers 3 sendonly video stream with 3 layers of SVC
  end note
  Alice->Bob: Offer(Audio:Opus Video: H.264 SVC) bundle-only
  note left of Bob
  Bob accepts Alice's Offered Codec operation points
  end note
  Bob->Alice: Answer(Video: H.264) bundle-only
  Alice->Bob: One-Way H.264 Video with codec points as indicated by Bob.
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20519 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE m0 m1	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:m0	[RFC5888] Audio m=line part of BUNDLE group with a unique port number
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]

a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]	
a=ptime:20	[draft-ietf-payload-rtp-opus]	
a=sendonly	[RFC3264]	
a=rtcp-fb:109 nack	[RFC5104]	

a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives	
a=rtcp-mux	[RFC5761]	
a=ice-ufrag:074c6550	[RFC5245]	
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]	
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]	
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]	
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]	
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]	
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]	
a=ssrc:67890 cname:axzo1278npDlAzM73	[RFC5576]	
a=rtcp-rsize	[RFC5506]	
m=video 0 UDP/TLS/RTP/SAVPF 96 97 100	bundle-only video line with port number set to zero	
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tc)	
c=IN IP4 24.23.204.141	[RFC4566]	
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]	
a=mid:m1	[RFC5888] Audio m=line	

		part of BUNDLE group
a=msid:ma tb		
a=rtpmap:96 H264/90000		[RFC3984]
a=fmtp:96		[RFC3984]H.264 Layer 1
profile-level-id=4d0028;packetization		
-mode=1;max-fr=30;max-fs=8040		
a=rtpmap:97 H264/90000		[RFC3984]
a=fmtp:97		[RFC3984] H.264 Layer 2
profile-level-id=4d0028;packetization		
-mode=1;max-fr=15;max-fs=1200		
a=rtpmap:100 H264-SVC/90000		[RFC3984]
a=fmtp:100		[RFC3984]
profile-level-id=4d0028;packetization		
-mode=1;max-fr=30;max-fs=8040		

a=depend:100 lay m1:96,97;		[RFC5583]Layer 3 dependent on layers 1 and 2
a=sendonly		[RFC3264] - Send only video stream
a=rtcp-mux		[RFC5761]
a=bundle-only		[draft-roach-mmusic-unified-plan]
a=ssrc:1732846380		[RFC5576]
cname:axzo1278npDlAzM73		
a=ssrc:1732846381		[RFC5576]
cname:axzo1278npDlAzM73		
a=ssrc:1732846382		[RFC5576]
cname:axzo1278npDlAzM73		
a=rtcp-fb:* nack		[RFC5104]
a=rtcp-fb:* nack pli		[RFC5104]
a=rtcp-fb:* ccm fir		[RFC5104]
a=rtcp-rsize		[RFC5506]

Table 28: 5.3.2 SDP Offer with SVC

SDP Contents	RFC#/Notes

v=0	[RFC4566]
o=- 20519 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE m0 m1	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:m0	[RFC5888] Audio m=line part of BUNDLE group with a unique port number

a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=rtcp-fb:109 nack	[RFC5104]
a=recvonly	[RFC3264]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c	[RFC5245]

7:70:9d:1f:66:79:a8:07		
a=candidate:0 1 UDP 2113667327 192.168.1.7 54609 typ host	[RFC5245]	
a=candidate:1 1 UDP 694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.5 rport 49203	[RFC5245]	
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]	
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.5 rport 60065	[RFC5245]	
a=rtcp-rsize	[RFC5506]	
m=video 54609 UDP/TLS/RTP/SAVPF 96 100	BUNDLE accepted Bundle address same as audio m=line.	
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)	
c=IN IP4 98.248.92.77	[RFC4566]	
a=rtcp:56503 IN IP4 98.248.92.77	[RFC3605]	
a=mid:m1	[RFC5888] Video m=line part of BUNDLE group	
a=rtpmap:96 H264/90000	[RFC3984]	
a=fmtp:96 profile-level-id=4d0028;packetization-mode=1;max-fr=30;max-fs=8040	[RFC3984]H.264 Layer 1	
a=rtpmap:100 H264-SVC/90000	[RFC3984]	

a=fmtp:100 profile-level-id=4d0028;packetization-mode=1;max-fr=30;max-fs=8040	[RFC3984]	
a=depend:100 lay m1:96;	[RFC5583] Bob chooses 2 Codec Operation points	
a=ice-ufrag:074c6550	[RFC5245]	
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]	
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]	

a=candidate:0 1 UDP 2113667327	[RFC5245]
192.168.1.5 54609 typ host	
a=candidate:1 1 UDP 694302207	[RFC5245]
24.23.204.142 54609 typ srflx raddr	
192.168.1.5 rport 54609	
a=candidate:0 2 UDP 2113667326	[RFC5245]
192.168.1.5 64678 typ host	
a=candidate:1 2 UDP 1694302206	[RFC5245]
24.23.204.142 64678 typ srflx raddr	
192.168.1.5 rport 64678	
a=recvonly	[RFC3264] - Receive only video stream
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761]
a=bundle-only	[draft-roach-mmusic-unified-plan]
a=ssrc:4638117328	[RFC5576]
cname:axzo1278npDlAzM73	
a=rtcp-rsize	[RFC5506]

Table 29: 5.3.2 SDP Answer with SVC

5.3.3. Successful Simulcast Video Streams with Retransmisson

This section shows an SDP Offer/Answer exchange for a simulcast scenario with 2 two resolutions and has [RFC4588] style re-transmission flows.


```
title Simulcast Streams with Retransmission

note right of Alice
Alice offers single audio and simulcasted video stream
```

```
end note
Alice->Bob: Offer(Audio:Opus Video:VP8 with 2 resolutions and RTX Stream) bundl
note left of Bob
Bob accepts all the streams offered by Alice
end note

Bob->Alice: Answer(Audio:Opus Video:VP8 with 2 resolutions and RTX Stream) bund

Alice<->Bob: 2 Way Audio and Simulcast Video with RTX Streams
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20519 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE m0 m1	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:m0	[RFC5888] Audio m=line part of BUNDLE group with a unique port number
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=rtcp-fb:109 nack	[RFC5104]
a=sendrecv	[RFC3264]

a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761]
a=ssrc:11111 cname:EocUG1f0fcg/yvY7	[RFC5576]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]
a=rtcp-rsize	[RFC5506]
m=video 0 UDP/TLS/RTP/SAVPF 98 100 101 103	bundle-only video line with port number set to zero
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:m1	[RFC5888] Audio m=line part of BUNDLE group
a=rtpmap:98 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:100 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:101 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:103 VP8/90000	[draft-ietf-payload-vp8]
a=fmtp:98 max-fr=30;max-fs=8040	[RFC4566]
a=fmtp:100 max-fr=15;max-fs=1200	[RFC4566]
a=fmtp:101 apt=98;rtx-time=3000	[RFC4588]
a=fmtp:103 apt=100;rtx-time=3000	[RFC4588]
a=ssrc-group:SIMULCAST 12345 78990	Simulcast group
a=ssrc-group:FID 12345 34567	[RFC5888]
a=ssrc-group:FID 78990 90887	[RFC5888]
a=ssrc:12345 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=ssrc:78990 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=ssrc:34567 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]

| a=ssrc:90887 cname:Q/NWs1ao1HmN4Xa5 | [RFC5576] |

a=sendrecv	[RFC3264]
a=rtcp-mux	[RFC5761]
a=bundle-only	[draft-roach-mmusic-unified-plan]
a=rtcp-fb:* nack	[RFC5104]
a=rtcp-fb:* nack pli	[RFC5104]
a=rtcp-fb:* ccm fir	[RFC5104]
a=rtcp-rsize	[RFC5506]

Table 30: 5.3.3 SDP Offer w/Simulcast, RTX

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20519 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE m0 m1	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:m0	[RFC5888] Audio m=line part of BUNDLE group with a unique port number
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1	[RFC6464]

urn:ietf:params:rtp-hdrext:ssrc-audi o-level	
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=rtcp-fb:109 nack	[RFC5104]
a=sendrecv	[RFC3264]
a=setup:active	[RFC4145]
a=rtcp-mux	[RFC5761]

a=ssrc:33333 cname:L/HmN4Xa5NWs1ao1	[RFC5576]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474a f08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 54609 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 98.248.92.77 54609 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 64678 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=rtcp-rsize	[RFC5506]
m=video 49203 UDP/TLS/RTP/SAVPF 98 100 101 103	BUNDLE accepted with Bundle address identical to audio m-line
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:m1	[RFC5888] Video m=line part of BUNDLE group
a=rtpmap:98 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:100 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:101 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:103 VP8/90000	[draft-ietf-payload-vp8]

a=fmtp:98 max-fr=30;max-fs=8040	[RFC4566]
a=fmtp:100 max-fr=15;max-fs=1200	[RFC4566]
a=fmtp:101 apt=98;rtx-time=3000	[RFC4588]
a=fmtp:103 apt=100;rtx-time=3000	[RFC4588]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]

a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.772 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=ssrc-group:SIMULCAST 54321 77656	Simulcast group
a=ssrc-group:FID 54321 88776	[RFC5888]
a=ssrc-group:FID 77656 12908	[RFC5888]
a=ssrc:54321 cname:LP/NWs1ao1HmN4Xa5	[RFC5576]
a=ssrc:77656 cname:LP/NWs1ao1HmN4Xa5	[RFC5576]
a=ssrc:88776 cname:LP/NWs1ao1HmN4Xa5	[RFC5576]
a=ssrc:12908 cname:LP/NWs1ao1HmN4Xa5	[RFC5576]
a=sendrecv	[RFC3264]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761]
a=bundle-only	[draft-roach-mmusic-unified-plan]
a=rtcp-fb:* nack	[RFC5104]
a=rtcp-fb:* nack pli	[RFC5104]
a=rtcp-fb:* ccm fir	[RFC5104]
a=rtcp-rsize	[RFC5506]

Table 31: 5.3.3 SDP Answer w/Simulcast, RTX

5.3.4. Successful 1-way Simulcast with 2 resolutions and RTX - One resolution rejected

This section shows an SDP Offer/Answer exchange for a simulcast scenario with 2 two resolutions and has [RFC4588] style re-transmission flows.

It also showcases when Bob rejects one of the Simulcast Video Stream which results in the rejection of the associated repair stream implicitly


```
title Simulcast Streams with Retransmission Rejected

note right of Alice
Alice offers sendonly single audio and simulcasted video stream.
end note
Alice->Bob: Offer(Audio:Opus Video:VP8 with 2 resolutions and RTX Streams) bund

note left of Bob
Bob accepts one simulcast,rtx and rejects the other
end note
Bob->Alice: Answer(Audio:Opus Video:VP8 with 1 resolution and the RTX Stream) b

Alice->Bob: 1 Way Audio, Video Session
note right of Alice
Only 1 Video stream and its associated RTX stream
is sent to Bob
end note
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20519 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE m0 m1	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:m0	[RFC5888] Audio m=line part of BUNDLE group with a unique port number
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]

a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=rtcp-fb:109 nack	[RFC5104]
a=sendonly	[RFC3264]
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761]
a=ssrc:11111 cname:LP/NWs1ao1HmN4Xa5	[RFC5576]

a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474a f08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]
a=rtcp-rsize	[RFC5506]
m=video 0 UDP/TLS/RTP/SAVPF 98 100 101 103	bundle-only video line with port number set to zero
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:m1	[RFC5888] Audio m=line part of BUNDLE group
a=rtpmap:98 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:100 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:101 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:103 VP8/90000	[draft-ietf-payload-vp8]
a=fmtp:98 max-fr=30;max-fs=8040	[RFC4566]
a=fmtp:100 max-fr=15;max-fs=1200	[RFC4566]
a=fmtp:101 apt=98;rtx-time=3000	[RFC4588]
a=fmtp:103 apt=100;rtx-time=3000	[RFC4588]

a=ssrc-group:SIMULCAST 12345 78990	Simulcast group
a=ssrc-group:FID 12345 34567	[RFC5888]
a=ssrc-group:FID 78990 90887	[RFC5888]
a=ssrc:12345 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=ssrc:78990 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]

a=ssrc:34567 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=ssrc:90887 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=sendonly	[RFC3264]
a=rtcp-mux	[RFC5761]
a=bundle-only	[draft-roach-mmusic-unified-plan]
a=rtcp-fb:* nack	[RFC5104]
a=rtcp-fb:* nack pli	[RFC5104]
a=rtcp-fb:* ccm fir	[RFC5104]
a=rtcp-rsize	[RFC5506]

Table 32: 5.3.4 SDP Offer w/Simulcast, RTX

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20519 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE m0 m1	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:49203 IN IP4 98.248.92.77	[RFC3605]
a=mid:m0	[RFC5888] Audio m=line part of BUNDLE group with a unique port number
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]

a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=recvonly	[RFC3264]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=rtcp-rsize	[RFC5506]
m=video 49203 UDP/TLS/RTP/SAVPF 98 101	BUNDLE accepted with Bundle address identical to audio m-line
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:m1	[RFC5888] Video m=line part of BUNDLE group
a=rtpmap:98 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:101 VP8/90000	[draft-ietf-payload-vp8]
a=fmtp:98 max-fr=30;max-fs=8040	[RFC4566]
a=fmtp:101 apt=98;rtx-time=3000	[RFC4588]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]

a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.5 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.5 rport 60065	[RFC5245]
a=ssrc:54321 cname:NWs1ao1HmN4Xa5	[RFC5576]
a=recvonly	[RFC3264]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761]
a=bundle-only	[draft-roach-mmusic-unified-plan]
a=rtcp-rsize	[RFC5506]

Table 33: 5.3.4 SDP Answer no Simulcast

5.3.5. Simulcast Video Stream with Forward Error Correction

This section shows an SDP Offer/Answer exchange for Simulcast video stream at two resolutions and and has [RFC5956] style FEC flows.

On completion of Offer/Answer exchange we end up one audio stream, 2 simulcast video streams and 2 associated FEC streams are sent over a single 5-tuple.

```
title Simulcast Streams with Forward Error Correction

note right of Alice
Alice offers sendonly single audio and simulcasted video stream
end note
Alice->Bob: Offer(Audio:Opus Video:VP8 with 2 resolutions with FEC Streams) bun

note left of Bob
Bob accepts simulcast stream as well as FEC streams
end note
```

```
Bob->Alice: Answer(Audio:Opus Video:VP8 with 2 resolutions with FEC Streams) bu

Alice->Bob: 1 Way Audio, Video Session
note right of Alice
Successful Session with 4 video streams (Simulcast + FEC) and 1 Audio Stream
```


SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20519 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE m0 m1	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:m0	[RFC5888] Audio m=line part of BUNDLE group with a unique port number
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=rtcp-fb:109 nack	[RFC5104]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145] - Alice can

		perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761]	
a=ssrc:11111 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]	
a=ice-ufrag:074c6550	[RFC5245]	
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]	
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]	
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]	

a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]	
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]	
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]	
a=rtcp-rsize	[RFC5506]	
m=video 0 UDP/TLS/RTP/SAVPF 98 100 101 103	bundle-only video line with port number set to zero	
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)	
c=IN IP4 24.23.204.141	[RFC4566]	
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]	
a=mid:m1	[RFC5888] Video m=line part of BUNDLE group	
a=rtpmap:98 VP8/90000	[draft-ietf-payload-vp8]	
a=rtpmap:100 VP8/90000	[draft-ietf-payload-vp8]	
a=rtpmap:101 1d-interleaved-parityfec/90000	[RFC5956]	
a=rtpmap:103 1d-interleaved-parityfec/90000	[RFC5956]	
a=fmtp:98 max-fr=30;max-fs=8040	[RFC4566]	
a=fmtp:100 max-fr=15;max-fs=1200	[RFC4566]	

a=fmtp:101 L=5; D=10;	[RFC5956]
repair-window=200000	
a=fmtp:103 L=5; D=10;	[RFC5956]
repair-window=200000	
a=ssrc-group:SIMULCAST 12345 78990	Simulcast group
a=ssrc-group:FEC-FR 12345 34567	[RFC5888]
a=ssrc-group:FEC-FR 78990 90887	[RFC5888]
a=ssrc:12345 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=ssrc:78990 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=ssrc:34567 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=ssrc:90887 cname:Q/NWs1ao1HmN4Xa5	[RFC5576]
a=sendrecv	[RFC3264]
a=rtcp-mux	[RFC5761]
a=bundle-only	[draft-roach-mmusic-unified-plan]
a=rtcp-fb:* nack	[RFC5104]
a=rtcp-fb:* nack pli	[RFC5104]
a=rtcp-fb:* ccm fir	[RFC5104]
a=rtcp-rsize	[RFC5506]

Table 34: 5.3.5 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20519 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE m0 m1	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID

	(ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:m0	[RFC5888] Audio m=line part of BUNDLE group with a unique port number
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=rtcp-fb:109 nack	[RFC5104]
a=sendrecv	[RFC3264]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761]
a=ssrc:33333 cname:Y9/cZke09JAtpl98	[RFC5576]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]

a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=rtcp-rsize	[RFC5506]
m=video 49203 UDP/TLS/RTP/SAVPF 98 100 101 103	BUNDLE accepted with Bundle Address identical to audio m=line.

a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=mid:m1	[RFC5888] Video m=line part of BUNDLE group
a=rtpmap:98 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:100 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:101 1d-interleaved-parityfec/90000	[RFC5956]
a=rtpmap:103 1d-interleaved-parityfec/90000	[RFC5956]
a=fmtp:98 max-fr=30;max-fs=8040	[RFC4566]
a=fmtp:100 max-fr=15;max-fs=1200	[RFC4566]
a=fmtp:101 L=5; D=10; repair-window=200000	[RFC5956]
a=fmtp:103 L=5; D=10; repair-window=200000	[RFC5956]
a=ssrc-group:SIMULCAST 54321 77656	Simulcast group
a=ssrc-group:FEC-FR 54321 88776	[RFC5888]
a=ssrc-group:FEC-FR 77656 12908	[RFC5888]
a=ssrc:54321 cname:Q/1HmN4Xa5CClapa	[RFC5576]
a=ssrc:77656 cname:Q/1HmN4Xa5CClapa	[RFC5576]
a=ssrc:88776 cname:Q/1HmN4Xa5CClapa	[RFC5576]
a=ssrc:12908 cname:Q/1HmN4Xa5CClapa	[RFC5576]
a=sendrecv	[RFC3264]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761]
a=bundle-only	[draft-roach-mmusic-unified-plan]

a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327	[RFC5245]

192.168.1.7 49203 typ host a=candidate:1 1 UDP 694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=rtcp-fb:* nack	[RFC5104]
a=rtcp-fb:* nack pli	[RFC5104]
a=rtcp-fb:* ccm fir	[RFC5104]
a=rtcp-rsize	[RFC5506]

Table 35: 5.3.5 SDP Answer

5.4. Others

The examples in the section provide SDP for a variety of scenarios related to RTP Header extension, Legacy Interop scenarios and more.

5.4.1. Audio Session - Voice Activity Detection

This example shows Alice indicating the support of the RTP header extension to include the audio-level of the audio sample carried in the RTP packet.

```
title 2-Way Audio with VAD

Alice->Bob: Offer(Audio:Opus,PCMU,PCMA)
note right of Alice
Alice indicates support for including audio-level
end note
Bob->Alice: Answer(Audio:Opus,PCMU,PCMA)
note left of Bob
Bob accepts and indicates his support as well
end note
Alice<->Bob: Two-way Opus Audio
note right of Alice
 Per packet audio-level is included in the RTP header.
```

end note

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio	[draft-ietf-mmusic-sdp-bundle-negotiation]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 54609 UDP/TLS/RTP/SAVPF 109 0 8	[RFC4566]
a=mid:audio	[RFC5888]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=extmap:1	[RFC6464]
urn:ietf:params:rtp-hdrext:ssrc-audio-level	
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=rtpmap:0 PCMU/8000	[RFC3551]
a=rtpmap:0 PCMA/8000	[RFC3551]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145]
a=rtcp-mux	[RFC5761]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]

a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]
a=rtcp-fb:* nack	[RFC5104]
a=ssrc:11111	[RFC5576]
cname:QCL/1HmN4Xa5CClapa	
a=rtcp-rsize	[RFC5506]

Table 36: 5.4.1 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio	[draft-ietf-mmusic-sdp-bundle-negotiation]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 49203 UDP/TLS/RTP/SAVPF 109 0 98	[RFC4566]
a=mid:audio	[RFC5888]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus] - Bob accepts only OpusCodec
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=rtpmap:0 PCMU/8000	[RFC3551] PCMU Audio Codec
a=rtpmap:0 PCMA/8000	[RFC3551] PCMA Audio Codec

a=rtcp-fb:* nack	[RFC5104]
a=sendrecv	[RFC3264] - Bob can send and recv audio

a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761] - Bob can perform RTP/RTCP Muxing on port 49203
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efb abd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9: c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=ssrc:1732846380 cname:EocUG1f0fcg/yvY7	[RFC5576]
a=rtcp-rsize	[RFC5506]

Table 37: 5.4.1 SDP Answer

5.4.2. Audio Conference - Voice Activity Detection

This example shows SDP for RTP header extension that allows RTP-level mixers in audio conferences to deliver information about the audio level of individual participants.

```
title Audio Conference with VAD Support
```

```
Alice->Mixer: Offer(Audio:Opus,PCMU,PCMA)
note right of Alice
Alice indicates its interest to audio levels for the contributing sources
end note
Mixer->Alice: Answer(Audio:Opus,PCMU,PCMA)
note left of Bob
Mixer indicates it can provide audio-levels per CSRC
end note
Alice<->Mixer: Two-way Opus Audio
note right of Alice
 Audio levels per CSRC is included in the RTP Header
```



```
end note
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio	[draft-ietf-mmusic-sdp-bundle-negotiation]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 54609 UDP/TLS/RTP/SAVPF 109 0 8	[RFC4566]
a=mid:audio	[RFC5888]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=extmap:1/recvonly	[RFC6465]
urn:ietf:params:rtp-hdrext:csrc-audio-level	
a=extmap:1	[RFC6464]
urn:ietf:params:rtp-hdrext:ssrc-audi	

o-level	
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus] - Opus Codec 48khz, 2 channels
a=ptime:20	[draft-ietf-payload-rtp-opus] - Opus packetization of20ms
a=rtpmap:0 PCMU/8000	[RFC3551] PCMU Audio Codec
a=rtpmap:0 PCMA/8000	[RFC3551] PCMA Audio Codec
a=rtcp-fb:* nack	[RFC5104]
a=sendrecv	[RFC3264] - Alice can send and recv audio
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761] - Alice can perform RTP/RTCP Muxing on port 54609
a=ice-ufrag:074c6550	[RFC5245]

a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]
a=ssrc:11111 cname:QCL/1HmN4Xa5CClapa	[RFC5576]
a=rtcp-rsize	[RFC5506]

Table 38: 5.4.2 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566] - Session Origin Information
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE audio	[draft-ietf-mmusic-sdp-bundle-negotiation]
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 49203 UDP/TLS/RTP/SAVPF 109 0 98	[RFC4566]

a=mid:audio	[RFC5888]
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
c=IN IP4 98.248.92.77	[RFC4566]
a=rtcp:60065 IN IP4 98.248.92.77	[RFC3605]
a=extmap:1/sendonly urn:ietf:params:rtp-hdrext:csrc-audio-level	[RFC6465]
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus] - Bob accepts only OpusCodec
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=rtpmap:0 PCMU/8000	[RFC3551] PCMU Audio Codec
a=rtpmap:0 PCMA/8000	[RFC3551] PCMA Audio Codec
a=rtcp-fb:* nack	[RFC5104]
a=sendrecv	[RFC3264] - Bob can send and recv audio
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=rtcp-mux	[RFC5761] - Bob can perform RTP/RTCP Muxing on port 49203
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]

a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206	[RFC5245]

| 98.248.92.77 60065 typ srflx raddr
192.168.1.7 rport 60065
a=ssrc:2222 cname:HmN4Xa5CC/lapa | [RFC5576] |
| a=rtcp-rsize | [RFC5506] |

Table 39: 5.4.2 SDP Answer

5.4.3. Successful legacy Interop Fallaback with bundle-only

In the scenario described below, Alice is a multi-stream capable WebRTC endpoint while Bob is a legacy VOIP end-point. The SDP Offer/Answer exchange demonstrates successful session setup with fallback to audio only stream negotiated via bundle-only framework between the end-points. Specifically,

- Offer from Alice describes 2 cameras via 2 video m=lines with both marked as bundle-only.
- Since Bob doesnot recognize either BUNDLE mechanism or bundle-only attribute, he accepts only the audio stream from Alice.

```
title Successful 2-Way WebRTC <-> VOIP Interop

note right of Alice
Alice is a multistream capable WebRTC end-point & Bob is behind a legacy VOIP s
end note
Alice->Bob: Offer(Audio:Opus Video: 2 VP8, 2 H2.64 Streams) with bundle-only of
note right of Alice
Alice marks both the video streams as bundle-only
end note
Bob->Alice: Answer(Audio:Opus)
note left of Bob
 Bob accepts only Audio stream since he doesn't recognize
 bundle-only streams
end note
Alice<->Bob: Two-way Opus Audio
```

| SDP Contents | RFC#/Notes |
| v=0 | [RFC4566] |

| o=- 20519 0 IN IP4 0.0.0.0 | [RFC4566] |

s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
a=group:BUNDLE m0 m1 m2	[draft-ietf-mmusic-sdp-bundle-negotiation] Alice supports grouping of m=lines under BUNDLE semantics
a=ice-options:trickle	[draft-ivov-mmusic-trickle-ice]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:m0	[RFC5888] Audio m=line part of BUNDLE group with a unique port number
a=msid:ma ta	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (ta)
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=rtcp-fb:109 nack	[RFC5104]
a=sendrecv	[RFC3264]
a=setup:actpass	[RFC4145] - Alice can perform DTLS before Answer arrives
a=rtcp-mux	[RFC5761]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.4 54609 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54609 typ srflx raddr 192.168.1.4 rport 54609	[RFC5245]
a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]

a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr 192.168.1.4 rport 64678	[RFC5245]
a=ssrc:11111 cname:axzo1278npDlAzM73	[RFC5576]E
a=rtcp-rsize	[RFC5506]
m=video 0 UDP/TLS/RTP/SAVPF 98 100	bundle-only video line with port number set to zero
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:m1	[RFC5888] Video m=line part of BUNDLE group
a=msid:ma tb	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tb)
a=rtpmap:98 VP8/90000	[draft-ietf-payload-vp8]
a=rtpmap:100 VP8/90000	[draft-ietf-payload-vp8]
a=imageattr:98 [x=1280,y=720]	[RFC6236]Camera-1,Encoding-1 Resolution
a=fmtp:98 max-fr=30	[RFC4566]
a=imageattr:100 [x=640,y=480]	[RFC6236] Camera-1,Encoding-2 Resolution
a=fmtp:100 max-fr=15	[RFC4566]
a=ssrc-group:SIMULCAST 12345 45678	[RFC5576]
a=ssrc:12345 cname:axzo1278npDlAzM73	[RFC5576]E
a=ssrc:45678 cname:axzo1278npDlAzM73	[RFC5576]
a=bundle-only	[draft-roach-mmusic-unified-plan]
a=rtcp-rsize	[RFC5506]
m=video 0 UDP/TLS/RTP/SAVPF 101 103	bundle-only video line with port number set to zero
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:64678 IN IP4 24.23.204.141	[RFC3605]
a=mid:m2	[RFC5888] Video m=line part of BUNDLE group
a=msid:ma tc	Identifies RTCMediaStream ID (ma) and RTCMediaStreamTrack ID (tc)
a=rtpmap:101 H264/90000	[RFC3984]
a=rtpmap:103 H264/90000	[RFC3984]
a=fmtp:101 profile-level-id=4d0028;packetizatio	[RFC3984]Camera-2,Encoding-1 Resolution

| n-mode=1;max-fr=30 | | |

a=fmtp:100 profile-level-id=4d0028;packetizatio n-mode=1;max-fr=15	[RFC3984]Camera-1,Encoding -2 Resolution
a=ssrc-group:SIMULCAST 67890 56789	[RFC5576]
a=ssrc:67890 cname:axzo1278npDlAzM73	[RFC5576]
a=ssrc:56789 cname:axzo1278npDlAzM73	[RFC5576]
a=bundle-only	[draft-roach-mmusic-unified-plan]
a=rtcp-rsize	[RFC5506]

Table 40: 5.4.3 SDP Simulcast bundle-only

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20519 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=msid-semantic:WMS	[MSID]
m=audio 49203 UDP/TLS/RTP/SAVPF 109	[RFC4566]
c=IN IP4 24.23.204.141	[RFC4566]
a=rtcp:60065 IN IP4 24.23.204.141	[RFC3605]
a=rtpmap:109 opus/48000/2	[draft-ietf-payload-rtp-opus]
a=extmap:1 urn:ietf:params:rtp-hdrext:ssrc-audio-level	[RFC6464]
a=ptime:20	[draft-ietf-payload-rtp-opus]
a=rtcp-fb:109 nack	[RFC5104]
a=sendrecv	[RFC3264]
a=setup:active	[RFC4145] - Bob carries out DTLS Handshake in parallel
a=ice-ufrag:ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=candidate:0 1 UDP 2113667327 192.168.1.7 49203 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207	[RFC5245]

98.248.92.77 49203 typ srflx raddr 192.168.1.7 rport 49203	
a=candidate:0 2 UDP 2113667326 192.168.1.7 60065 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 98.248.92.77 60065 typ srflx raddr 192.168.1.7 rport 60065	[RFC5245]
a=rtcp-rsize	[RFC5506]
m=video 0 UDP/TLS/RTP/SAVPF 98 100	Bob doesn't recognize bundle-only and hence rejects the video stream
c=IN IP4 98.248.92.77	[RFC4566]
a=rtpmap:98 VP8/90000	[draft-ietf-payload-vp8]

a=rtpmap:100 VP8/90000	[draft-ietf-payload-vp8]
a=imageattr:98 [x=1280,y=720]	[RFC6236]Camera-1,Encoding-1 Resolution
a=fmtp:98 max-fr=30	[RFC4566]
a=imageattr:100 [x=640,y=480]	[RFC6236] Camera-1,Encoding-2 Resolution
a=fmtp:100 max-fr=15	[RFC4566]
m=video 0 UDP/TLS/RTP/SAVPF 98 100	Bob doesn't recognize bundle-only and hence rejects the video stream
c=IN IP4 98.248.92.77	[RFC4566]
a=rtpmap:101 H264/90000	[RFC3984]
a=rtpmap:103 H264/90000	[RFC3984]
a=fmtp:101 profile-level-id=4d0028;packetization-mode=1;max-fr=30	[RFC3984]Camera-2,Encoding-1 Resolution
a=fmtp:100 profile-level-id=4d0028;packetization-mode=1;max-fr=15	[RFC3984]Camera-1,Encoding-2 Resolution

Table 41: 5.4.3 SDP Anwer

5.4.4. Legacy Interop with RTP/AVP profile

In this section, we attempt to provide session descriptions showcasing inter-operability between a WebRTC end-point and a Legacy VOIP end-point. The ideas included in here are not fully baked into the standards and might be controversial in nature. The hope here is to demonstrate a plausible SDP composition to enchance seamless inter-operability between the aforementioned communication systems.

In the scenario desribed below, Alice sends [RFC3264] Offer with two sets of media descriptions per media type.

- One set that correponds to [WebRTC] compliant UDP/TLS/RTP/SAVPF based audio and video descriptions.
- Another set with RTP/AVP based audio and video descriptions for the legacy Interop purposes.
- Also to note, Alice includes session level DTLS information and media level RTCP feedback information as applicable to both the sets of media descriptions

On the other hand, Bob being a Legacy VOIP end-point, recognizes only the media descriptions with RTP/AVP as the application protocol. The security and fedback requirements for the session are either handled

by a intermediate gateway or with some combination of Bob's capabilities and the intermediate gateway.

```
title Successful 2-Way WebRTC <-> VOIP Interop
note right of Alice
Alice is on a WebRTC end-point & Bob is behind a legacy VOIP system
end note
Alice->Bob: Offer(Audio:Opus Video:VP8)
note right of Alice
 Alice includes 2 copies of media descriptions
 1. WebRTC compliant media description (UDP/TLS/RTP/SAVPF)
 2. Legacy compliant media description (RTP/AVP)
end note
Bob->Alice: Answer(Audio:Opus Video:VP8)
note right of Bob
 Bob recognizes"legacy compliant" media description from Alice.
 and accepts the same.
end note
```

```
Alice->Bob: Two-way Opus Audio, VP8 Video
note right of Alice
  Session also suports RTP/RTCP Mux, RTCP feedback (nack,pli)
end note
```

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 20518 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=ice-ufrag:074c6550	[RFC5245]
a=ice-pwd:a28a397a4c3f31747d1ee3474af08a068	[RFC5245]
a=fingerprint:sha-1	[RFC5245]
99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9	
d:1f:66:79:a8:07	
a=rtcp-rsize	[RFC5506]
m=audio 54609 UDP/TLS/RTP/SAVPF 109	[RFC4566]
c=IN IP4 24.23.204.141	[RFC4566]
a=rtpmap:109 opus/48000	
a=ptime:20	
a=sendrecv	[RFC3264]
a=rtcp-mux	[RFC5761]
a=candidate:0 1 UDP 2113667327 192.168.1.4	[RFC5245]
54609 typ host	
a=candidate:1 1 UDP 694302207 24.23.204.141	[RFC5245]
54609 typ srflx raddr 192.168.1.4 rport	
54609	

a=candidate:0 2 UDP 2113667326 192.168.1.4	[RFC5245]
64678 typ host	
a=candidate:1 2 UDP 1694302206	[RFC5245]
24.23.204.141 64678 typ srflx raddr	
192.168.1.4 rport 64678	
a=rtcp-fb:109 nack	[RFC5104]
m=video 62537 UDP/TLS/RTP/SAVPF 120	[RFC4566]
c=IN IP4 24.23.204.141	[RFC4566]
a=rtpmap:120 VP8/90000	[draft-ietf-payload -vp8]
a=sendrecv	[RFC3264]

a=rtcp-mux	[RFC5761]
a=candidate:0 1 UDP 2113667327 192.168.1.4 62537 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 24.23.204.141 62537 typ srflx raddr 192.168.1.4 rport 62537	[RFC5245]
a=candidate:0 2 2113667326 192.168.1.4 54721 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 54721 typ srflx raddr 192.168.1.4 rport 54721	[RFC5245]
a=rtcp-fb:120 nack pli	[RFC5104]
a=rtcp-fb:120 ccm fir	[RFC5104]
----------	These set of media descriptions are for Legacy Inter-op purposes
m=audio 54732 RTP/AVP 109	[RFC4566]Alice includes RTP/AVP audio stream description
c=IN IP4 24.23.204.141	[RFC4566]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:7f:7d:f9:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=rtpmap:109 opus/48000	
a=ptime:20	
a=sendrecv	[RFC3264]
a=rtcp-mux	[RFC5761]Alice still includes RTP/RTCP Mux support
a=candidate:0 1 UDP 2113667327 192.168.1.4 54732 typ host	[RFC5245]
a=candidate:1 1 UDP 694302207 24.23.204.141 54732 typ srflx raddr 192.168.1.4 rport 54732	[RFC5245]

a=candidate:0 2 UDP 2113667326 192.168.1.4 64678 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 64678 typ srflx raddr	[RFC5245]

192.168.1.4 rport 64678	
a=rtcp-fb:109 nack	[RFC5104]She adds her intent for NACK RTCP feedback support
m=video 62445 RTP/AVP 120	[RFC4566]Alice includes RTP/AVP video stream description
c=IN IP4 24.23.204.141	[RFC4566]
a=fingerprint:sha-1 99:41:49:83:4a:97:0e:1f:ef:7d:f7:c9:c7:70:9d:1f:66:79:a8:07	[RFC5245]
a=rtpmap:120 VP8/90000	[draft-ietf-payload-vp8]
a=sendrecv	[RFC3264]
a=rtcp-mux	[RFC5761]Alice intends to perform RTP/RTCP Mux
a=candidate:0 1 UDP 2113667327 192.168.1.4 62445 typ host	[RFC5245]
a=candidate:1 1 UDP 1694302207 24.23.204.141 62537 typ srflx raddr 192.168.1.4 rport 62445	[RFC5245]
a=candidate:0 2 2113667326 192.168.1.4 54721 typ host	[RFC5245]
a=candidate:1 2 UDP 1694302206 24.23.204.141 54721 typ srflx raddr 192.168.1.4 rport 54721	[RFC5245]
a=rtcp-fb:120 nack pli	[RFC5104] Alice indicates support for Picture loss Indication and NACK RTCP feedback
a=rtcp-fb:120 ccm fir	[RFC5104]

Table 42: 5.4.5 SDP Offer

SDP Contents	RFC#/Notes
v=0	[RFC4566]
o=- 16833 0 IN IP4 0.0.0.0	[RFC4566]
s=-	[RFC4566]
t=0 0	[RFC4566]
a=ice-ufrag:c300d85b	[RFC5245]
a=ice-pwd:de4e99bd291c325921d5d47efbabd9a2	[RFC5245]
a=fingerprint:sha-1	[RFC5245]
99:41:49:83:4a:97:0e:1f:ef:6d:f7:c9:c7:70:9	
d:1f:66:79:a8:07	
m=audio 49203 RTP/AVP 109	[RFC4566] Bob
	accepts RTP/AVP
	based audio stream
c=IN IP4 98.248.92.77	[RFC4566]
a=rtpmap:109 opus/48000	
a=ptime:20	
a=sendrecv	[RFC3264]
a=candidate:0 1 UDP 2113667327 192.168.1.7	[RFC5245]
49203 typ host	
a=candidate:1 1 UDP 1694302207 98.248.92.77	[RFC5245]
49203 typ srflx raddr 192.168.1.7 rport	
49203	
a=candidate:0 2 UDP 2113667326 192.168.1.7	[RFC5245]
60065 typ host	
a=candidate:1 2 UDP 1694302206 98.248.92.77	[RFC5245]
60065 typ srflx raddr 192.168.1.7 rport	
60065	
m=video 63130 RTP/SAVP 120	[RFC4566] Bob
	accepts RTP/AVP
	based video stram
c=IN IP4 98.248.92.771	[RFC4566]
a=rtpmap:120 VP8/90000	[draft-ietf-payload
	-vp8]
a=sendrecv	[RFC3264]
a=candidate:0 1 UDP 2113667327 192.168.1.7	[RFC5245]
63130 typ host	
a=candidate:1 1 UDP 1694302207 98.248.92.77	[RFC5245]
63130 typ srflx raddr 192.168.1.7 rport	
63130	
a=candidate:0 2 UDP 2113667326 192.168.1.7	[RFC5245]
56607 typ host	
a=candidate:1 2 UDP 1694302206 98.248.92.77	[RFC5245]
56607 typ srflx raddr 192.168.1.7 rport	
56607	

Table 43: 5.4.5 SDP Answer

6. IANA Considerations

This document requires no actions from IANA.

7. Acknowledgments

We would like to thanks Justin Uberti for his detailed review and inputs.

8. Change Log

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

Changes from draft-nandakumar-rtcweb-sdp-03
- Aligned more closely with JSEP version -05
- Added Conventions to help readability
- Add more examples to clarify BUNDLE use-cases

Changes from draft-nandakumar-rtcweb-sdp-02
- Major refactoring was done to group the examples in to categories
- SDP was updated through out to reflect JSEP-04 style of defining attributes per m=line than at the session level.
- Added 8 new examples.
- Updated references for Trickle, Unified Plan
- Add section to explain the syntax conventions followed in the examples.

Changes from draft-nandakumar-rtcweb-sdp-01
- Updated references to OPUS RTP Payload Specification.
- Updated BUNDLE examples based on the latest draft-ietf-mmusic-sdp-bundle-negotiation.
- Added examples for multiple audio and video flows based on Unified Plan.
- Added new examples for RTX and FEC streams
- Updated Simulcast and SVC examples

Changes from draft-nandakumar-rtcweb-sdp-00

- Fixed editorial comments on the mailing list.
- Updated Data-channel SDP information based on draft-ietf-mmusic-sctp-sdp.
- Updated BUNDLE examples based on draft-ietf-mmusic-sdp-bundle-negotiation.

- Added examples for few more BUNDLE variants
- Added new examples for Simulcast and SVC

9. References

9.1. Normative References

[RFC3264] Rosenberg, J. and H. Schulzrinne, "An Offer/Answer Model with Session Description Protocol (SDP)", RFC 3264, June 2002.

[RFC4566] Handley, M., Jacobson, V., and C. Perkins, "SDP: Session Description Protocol", RFC 4566, July 2006.

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

9.2. Informative References

[RFC5245] Rosenberg, J., "Interactive Connectivity Establishment (ICE): A Protocol for Network Address Translator (NAT) Traversal for Offer/Answer Protocols", RFC 5245, July 2006.

[WebRTC] W3C, "WebRTC 1.0: Real-time Communication Between Browsers", <http://dev.w3.org/2011/webrtc/editor/webrtc.html> .

[JSEP] Uberti, J. and C. Jennigs, "Javascript Session Establishment Protocol", draft-ietf-rtcweb-jsep (work in progress), December 2012.

[MSID] Alvestrand, H., "Cross Session Stream Identification in the Session Description Protocol", Internet-Draft draft-ietf-mmusic-msid, January 2014.

[RFC5506] Johansson, I., "Support for Reduced-Size Real-Time Transport Control Protocol (RTCP): Opportunities and Consequences", RFC 5506, April 2009.

[RFC3551] Schulzrinne, H. and S. Casner, "RTP Profile for Audio and Video Conferences with Minimal Control", RFC 3551, July 2003.

[RFC3952] Duric, A. and S. Andersen, "Real-time Transport Protocol (RTP) Payload Format for internet Low Bit Rate Codec (iLBC) Speech", RFC 3952, December 2004.

[RFC4796] Hautakorpi, J. and G. Camarillo, "The Session Description Protocol (SDP) Content Attribute", RFC 4796, February 2007.

[RFC5761] Perkins, C. and M. Westerlund, "Multiplexing RTP Data and Control Packets on a Single Port", RFC 5761, April 2010.

[RFC3556] Casner, S., "Session Description Protocol (SDP) Bandwidth Modifiers for RTP Control Protocol (RTCP) Bandwidth", RFC 3556, July 2003.

[RFC5104] Wenger, S., Chandra, U., Westerlund, M., and B. Burman, "Codec Control Messages in the RTP Audio-Visual Profile with Feedback (AVPF)", RFC 5104, February 2008.

[RFC4588] Rey, J., Leon, D., Miyazaki, A., Varsa, V., and R. Hakenberg, "RTP Retransmission Payload Format", RFC 4588, July 2006.

[RFC5956] Begen, A., "Forward Error Correction Grouping Semantics in the Session Description Protocol", RFC 5956, September 2010.

[RFC5888] Camarillo, G. and H. Schulzrinne, "RTP Payload Format for H.264 Video", RFC 5888, June 2010.

[RFC6236] Johansson, I. and K. Jung, "Negotiation of Generic Image Attributes in the Session Description Protocol (SDP)", RFC 6236, May 2011.

[draft-ietf-payload-rtp-opus] Spittka, J., Vos, K., and JM. Valin, "RTP Payload Format for Opus Speech and Audio Codec", draft-ietf-payload-rtp-opus-00 (work in progress), July 2012.

[draft-ietf-payload-vp8] Westin, P., Lundin, H., Glover, M., Uberti, J., and F. Galligan, "RTP Payload Format for VP8 Video", draft-ietf-payload-vp8-05 (work in progress), August 2012.

[RFC3984] Wenger, S., Hannuksela, M., Stockhammer, T., Westerlund, M., and D. Singer, "RTP Payload Format for H.264 Video", RFC 3984, February 2005.

[RFC5583] Schierl, T. and S. Wenger, "Signaling Media Decoding Dependency in the Session Description Protocol (SDP)", RFC 5583, July 2009.

[RFC5576] Lennox, J., Ott, J., and T. Schierl, "Source-Specific Media Attributes in the Session Description Protocol (SDP)", RFC 5576, June 2009.

[draft-ietf-rtcweb-data-channel] Jesup, R., Loreto, S., and M. Tuexen, "RTCWeb Datagram Connection", draft-ietf-rtcweb-data-channel-01 (work in progress), September 2012.

[draft-ietf-mmusic-sctp-sdp] Loreto, S. and G. Camarillo, "Stream Control Transmission Protocol (SCTP)-Based Media Transport in the Session Description Protocol (SDP)", draft-ietf-mmusic-sctp-sdp-03 (work in progress), September 2012.

[draft-ietf-mmusic-sdp-bundle-negotiation] Holmberg, C., Alvestrand, H., and C. Jennings, "Multiplexing Negotiation Using Session Description Protocol (SDP) Port Numbers",

draft-ietf-mmusic-sdp-bundle-negotiation-04 (work in progress), February 2013.

[draft-roach-mmusic-unified-plan]
Roach, A., Uberti, J., and M. Thomson, "A Unified Plan for Using SDP with Large Numbers of Media Flows", draft-roach-mmusic-unified-plan (work in progress), July 2013.

[draft-ivov-mmusic-trickle-ice]
Roach, A., Uberti, J., and M. Thomson, "A Unified Plan for Using SDP with Large Numbers of Media Flows", draft-ivov-mmusic-trickle-ice-01 (work in progress), July 2013.

[draft-lennox-mmusic-sdp-source-selection]
Lennox, J. and H. Schulzrinne, "Multiplexing Negotiation Using Session Description Protocol (SDP) Port Numbers", draft-lennox-mmusic-sdp-source-selection-05 (work in progress), October 2012.

[draft-rescorla-avtcore-6222bis]
Rescorla, E. and A. Begen, "Guidelines for Choosing RTP Control Protocol (RTCP) Canonical Names (CNAMEs)", draft-rescorla-avtcore-6222bis-00 (work in progress), October 2012.

[RFC3550] Schulzrinne, H., Schulzrinne, S., Frederick, R., and V. Jacobson, "RTP: A Transport Protocol for Real-Time

Applications", RFC 2326, July 2003.

[RFC3261] Rosenberg, J., Schulzrinne, H., Camarillo, G., Johnston, A., Peterson, J., Sparks, R., Handley, M., and E. Schooler, "SIP: Session Initiation Protocol", RFC 3261, June 2002.

[RFC2326] Schulzrinne, H., Rao, A., and R. Lanphier, "Real Time Streaming Protocol (RTSP)", RFC 2326, April 1998.

[RFC3605] Huitema, C., "Real Time Control Protocol (RTCP) attribute in Session Description Protocol (SDP)", RFC 4145,

October 2003.

[RFC4145] Fischl, J., Tschofenig, H., and E. Rescorla, "Framework for Establishing a Secure Real-time Transport Protocol (SRTP) Security Context Using Datagram Transport Layer Security (DTLS)", RFC 4145, May 2010.

[RFC2833] Schulzrinne, H. and S. Petrack, "RTP Payload for DTMF Digits, Telephony Tones and Telephony Signals", RFC 2833, May 2000.

[RFC6464] Lennox, J., Ivov, E., and E. Marocco, "A Real-time Transport Protocol (RTP) Header Extension for Client-to-Mixer Audio Level Indication", RFC 6464, December 2011.

[RFC6465] Ivov, E., Marocco, E., and J. Lennox, "A Real-time Transport Protocol (RTP) Header Extension for Mixer-to-Client Audio Level Indication", RFC 6465, December 2011.

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