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Negotiating Media Multiplexing Using the Session Description Protocol
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Abstract

This specification defines a new Session Description Protocol (SDP) Grouping Framework extension, 'BUNDLE'. The extension can be used with the SDP Offer/Answer mechanism to negotiate the usage of a single address:port combination (BUNDLE address) for receiving media, referred to as bundled media, associated with multiple SDP media descriptions ("m=" lines).

To assist endpoints in negotiating the use of bundle this specification defines a new SDP attribute, 'bundle-only', which can be used to request that specific media is only used if bundled. This specification also updates sections 5.1, 8.1 and 8.2 of RFC 3264 to allow an answerer to assign a non-zero port value to an "m=" line in an SDP answer, even if the "m=" line in the associated SDP offer contained a zero port value.

There are multiple ways to correlate the bundled RTP packets with the appropriate media descriptions. This specification defines a new RTCP source description (SDS) item and a new RTP header extension that provides an additional way to do this correlation by using them to carry a value that associates the RTP/RTCP packets with a specific media description.

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Table of Contents

1.	Introduction	4
2.	Terminology	5
3.	Conventions	6
4.	Applicability Statement	7
5.	SDP Grouping Framework BUNDLE Extension	7
6.	SDP 'bundle-only' Attribute	7
7.	SDP Information Considerations	8
7.1.	General	8
7.2.	Connection Data (c=)	9
7.3.	Bandwidth (b=)	9
7.4.	Attributes (a=)	9
8.	SDP Offer/Answer Procedures	9
8.1.	General	9
8.2.	Generating the Initial SDP Offer	10
8.2.1.	General	10
8.2.2.	Suggesting the offerer BUNDLE address	11
8.3.	Generating the SDP Answer	11
8.3.1.	General	11
8.3.2.	Answerer Selection of Offerer Bundle Address	12
8.3.3.	Answerer Selection of Answerer BUNDLE Address	13
8.3.4.	Moving A Media Description Out Of A BUNDLE Group	13
8.3.5.	Rejecting A Media Description In A BUNDLE Group	13
8.4.	Offerer Processing of the SDP Answer	14
8.4.1.	General	14

8.4.2.	Bundle Address Synchronization (BAS)	14
8.5.	Modifying the Session	15
8.5.1.	General	15
8.5.2.	Suggesting a new offerer BUNDLE address	15
8.5.3.	Adding a media description to a BUNDLE group	16
8.5.4.	Moving A Media Description Out Of A BUNDLE Group	17
8.5.5.	Disabling A Media Description In A BUNDLE Group	17
9.	Protocol Identification	17
9.1.	General	17
9.2.	STUN, DTLS, SRTP	18
10.	RTP Considerations	18
10.1.	Single RTP Session	18
10.1.1.	General	18
10.1.2.	Payload Type (PT) Value Reuse	19
10.2.	Associating RTP/RTCP Packets With Correct SDP Media Description	19
10.3.	RTP/RTCP Multiplexing	20
10.3.1.	General	20
10.3.2.	SDP Offer/Answer Procedures	20
11.	ICE Considerations	23
11.1.	General	23
11.2.	SDP Offer/Answer Procedures	23
11.2.1.	General	23
11.2.2.	Generating the Initial SDP Offer	24
11.2.3.	Generating the SDP Answer	24
11.2.4.	Offerer Processing of the SDP Answer	24
11.2.5.	Modifying the Session	24
12.	Update to RFC 3264	24
12.1.	General	24
12.2.	Original text of section 5.1 (2nd paragraph) of RFC 3264	25
12.3.	New text replacing section 5.1 (2nd paragraph) of RFC 3264	25
12.4.	Original text of section 8.2 (2nd paragraph) of RFC 3264	25
12.5.	New text replacing section 8.2 (2nd paragraph) of RFC 3264	25
12.6.	Original text of section 8.4 (6th paragraph) of RFC 3264	26
12.7.	New text replacing section 8.4 (6th paragraph) of RFC 3264	26
13.	RTP/RTCP extensions for identification-tag transport	26
13.1.	General	26
13.2.	RTCP MID SDES Item	27
13.3.	RTP MID Header Extension	28
14.	IANA Considerations	28
14.1.	New SDES item	28
14.2.	New RTP Header Extension URI	29
14.3.	New SDP Attribute	29
15.	Security Considerations	29
16.	Examples	30

16.1.	Example: Bundle Address Selection	30
16.2.	Example: BUNDLE Extension Rejected	32
16.3.	Example: Offerer Adds A Media Description To A BUNDLE Group	33
16.4.	Example: Offerer Moves A Media Description Out Of A BUNDLE Group	36
16.5.	Example: Offerer Disables A Media Description Within A BUNDLE Group	37
17.	Acknowledgements	38
18.	Change Log	39
19.	References	44
19.1.	Normative References	44
19.2.	Informative References	44
Appendix A.	Design Considerations	45
A.1.	General	45
A.2.	UA Interoperability	46
A.3.	Usage of port number value zero	47
A.4.	B2BUA And Proxy Interoperability	47
A.4.1.	Traffic Policing	48
A.4.2.	Bandwidth Allocation	48
A.5.	Candidate Gathering	49
	Authors' Addresses	49

1. Introduction

This specification defines a way to use a single address:port combination (BUNDLE address) for receiving media associated with multiple SDP media descriptions ("m=" lines).

This specification defines a new SDP Grouping Framework [RFC5888] extension called 'BUNDLE'. The extension can be used with the Session Description Protocol (SDP) Offer/Answer mechanism [RFC3264] to negotiate the usage of a BUNDLE group. Within the BUNDLE group, a BUNDLE address is used for receiving media associated with multiple "m=" lines. This is referred to as bundled media.

The offerer and answerer [RFC3264] use the BUNDLE extension to negotiate the BUNDLE addresses, one for the offerer (offerer BUNDLE address) and one for the answerer (answerer BUNDLE address), to be used for receiving the bundled media associated with a BUNDLE group. Once the offerer and the answerer have negotiated a BUNDLE group, they assign their respective BUNDLE address to each "m=" line in the BUNDLE group. The BUNDLE addresses are used to receive all media associated with the BUNDLE group.

The use of a BUNDLE group and a BUNDLE address also allows the usage of a single set of Interactive Connectivity Establishment (ICE) [RFC5245] candidates for multiple "m=" lines.

This specification also defines a new SDP attribute, 'bundle-only', which can be used to request that specific media is only used if kept within a BUNDLE group.

As defined in RFC 4566 [RFC4566], the semantics of assigning the same port value to multiple "m=" lines are undefined, and there is no grouping defined by such means. Instead, an explicit grouping mechanism needs to be used to express the intended semantics. This specification provides such an extension.

This specification also updates sections 5.1, 8.1 and 8.2 of RFC 3264 [RFC3264]. The update allows an answerer to assign a non-zero port value to an "m=" line in an SDP answer, even if the "m=" line in the associated SDP offer contained a zero port value.

This specification also defines a new Real-time Transport Protocol (RTP) [RFC3550] SDES item and a new RTP header extension that can be used to carry a value that associates RTP/RTCP packets with a specific media description. This can be used to correlate a RTP packet with the correct media.

SDP bodies can contain multiple BUNDLE groups. A given BUNDLE address MUST only be associated with a single BUNDLE group. The procedures in this specification apply independently to a given BUNDLE group. All RTP based media flows associated with a single BUNDLE group belong to a single RTP session [RFC3550].

The BUNDLE extension is backward compatible. Endpoints that do not support the extension are expected to generate offers and answers without an SDP 'group:BUNDLE' attribute, and are expected to assign a unique address to each "m=" line within an offer and answer, according to the procedures in [RFC4566] and [RFC3264]

2. Terminology

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

Unique address: An IP address and port combination that is assigned to only one "m=" line in an offer or answer.

Shared address: An IP address and port combination that is assigned to multiple "m=" lines within an offer or answer.

Offerer BUNDLE-tag: The first identification-tag in a given SDP 'group:BUNDLE' attribute identification-tag list in an offer.

Answerer BUNDLE-tag: The first identification-tag in a given SDP 'group:BUNDLE' attribute identification-tag list in an answer.

Offerer BUNDLE address: Within a given BUNDLE group, an IP address and port combination used by an offerer to receive all media associated with each "m=" line within the BUNDLE group.

Answerer BUNDLE address: Within a given BUNDLE group, an IP address and port combination used by an answerer to receive all media associated with each "m=" line within the BUNDLE group.

BUNDLE group: A set of "m=" lines, created using an SDP Offer/Answer exchange, which uses the same BUNDLE address for receiving media.

Bundled "m=" line: An "m=" line, whose identification-tag is placed in an SDP 'group:BUNDLE' attribute identification-tag list in an offer or answer.

Bundle-only "m=" line: A bundled "m=" line with an associated SDP 'bundle-only' attribute.

Bundled media: All media associated with a given BUNDLE group.

Initial offer: The first offer, within an SDP session (e.g. a SIP dialog when the Session Initiation Protocol (SIP) [RFC3261] is used to carry SDP), in which the offerer indicates that it wants to create a given BUNDLE group.

Subsequent offer: An offer which contains a BUNDLE group that has been created as part of a previous offer/answer exchange.

Identification-tag: A unique token value that is used to identify an "m=" line. The SDP 'mid' attribute [RFC5888], associated with an "m=" line, carries a unique identification-tag. The session-level SDP 'group' attribute [RFC5888] carries a list of identification-tags, identifying the "m=" lines associated with that particular 'group' attribute.

3. Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14, RFC 2119 [RFC2119].

4. Applicability Statement

The mechanism in this specification only applies to the Session Description Protocol (SDP) [RFC4566], when used together with the SDP offer/answer mechanism [RFC3264]. Declarative usage of SDP is out of scope of this document, and is thus undefined.

5. SDP Grouping Framework BUNDLE Extension

This section defines a new SDP Grouping Framework extension [RFC5888], 'BUNDLE'. The BUNDLE extension can be used with the SDP Offer/Answer mechanism to negotiate the usage of a single address:port combination (BUNDLE address) for receiving bundled media.

A single address:port combination is also used for sending bundled media. The address:port combination used for sending bundled media MAY be the same as the BUNDLE address, used to receive bundled media, depending on whether symmetric RTP is used. A given address:port combination MUST NOT be used for sending media associated with multiple BUNDLE groups.

All media associated with a BUNDLE group share a single 5-tuple, i.e. in addition to using a single address:port combination all bundled media MUST be transported using the same transport-layer protocol (e.g. UDP or TCP).

The BUNDLE extension is indicated using an SDP 'group' attribute with a "BUNDLE" semantics value [RFC5888]. An identification-tag is assigned to each bundled "m=" line, and each identification-tag is listed in the SDP 'group:BUNDLE' attribute identification-tag list. Each "m=" line, whose identification-tag is listed in the identification-tag list, is associated with a given BUNDLE group.

SDP bodies can contain multiple BUNDLE groups. Any given bundled "m=" line MUST NOT be associated with more than one BUNDLE group.

Section 8 defines the detailed SDP Offer/Answer procedures for the BUNDLE extension.

6. SDP 'bundle-only' Attribute

This section defines a new SDP media-level attribute [RFC4566], 'bundle-only'.

Name: bundle-only

Value:

Usage Level: media

Charset Dependent: no

Example:

a=bundle-only

In order to ensure that an answerer that does not supports the BUNDLE extension always rejects a bundled "m=" line, the offerer can assign a zero port value to the "m=" line. According to [RFC4566] an answerer will reject such "m=" line. By associating an SDP 'bundle-only' attribute with such "m=" line, the offerer can request that the answerer accepts the "m=" line if the answerer supports the Bundle extension, and if the answerer keeps the "m=" line within the associated BUNDLE group.

NOTE: Once an offerer BUNDLE address has been selected, the offerer can ensure that an bundled "m=" line is accepted by the answerer only if the answerer keeps the "m=" line within the associated BUNDLE group by assigning the offerer BUNDLE address to the "m=" line. If the answerer does not keep that "m=" line within the BUNDLE group, the answerer will reject it. Therefore, the SDP 'bundle-only' attribute is not needed in such cases

The usage of the 'bundle-only' attribute is only defined for a bundled "m=" line with a zero port value, within an offer. Other usage is unspecified.

Section 8 defines the detailed SDP Offer/Answer procedures for the 'bundle-only' attribute.

7. SDP Information Considerations

7.1. General

This section describes restrictions associated with the usage of SDP parameters within a BUNDLE group. It also describes, when parameter and attribute values have been associated with each bundled "m=" line, how to calculate a value for the whole BUNDLE group.

7.2. Connection Data (c=)

The "c=" line nettype value [RFC4566] associated with a bundled "m=" line MUST be 'IN'.

The "c=" line addrtype value [RFC4566] associated with a bundled "m=" line MUST be 'IP4' or 'IP6'. The same value MUST be associated with each "m=" line.

NOTE: Extensions to this specification can specify usage of the BUNDLE mechanism for other nettype and addrtype values than the ones listed above.

7.3. Bandwidth (b=)

The proposed bandwidth for a bundled "m=" line SHOULD be calculated in the same way as for a non-bundled "m=" line.

The total proposed bandwidth for a BUNDLE group is the sum of the proposed bandwidth for each bundled "m=" line.

The total proposed bandwidth for an offer or answer is the sum of the proposed bandwidth for each "m=" line (bundled and non-bundled) within the offer or answer.

7.4. Attributes (a=)

An offerer and answerer MUST use the rules and restrictions defined in [I-D.mmusic-sdp-mux-attributes] for when associating SDP attributes with bundled "m=" lines.

8. SDP Offer/Answer Procedures

8.1. General

This section describes the SDP Offer/Answer [RFC3264] procedures for:

- o Negotiating and creating of a BUNDLE group;
- o Selecting the BUNDLE addresses (offerer BUNDLE address and answerer BUNDLE address);
- o Adding an "m=" line to a BUNDLE group;
- o Moving an "m=" line out of a BUNDLE group; and
- o Disabling an "m=" line within a BUNDLE group.

The generic rules and procedures defined in [RFC3264] and [RFC5888] also apply to the BUNDLE extension. For example, if an offer is rejected by the answerer, the previously negotiated SDP parameters and characteristics (including those associated with a BUNDLE group) apply. Hence, if an offerer generates an offer in which the offerer wants to create a BUNDLE group, and the answerer rejects the offer, the BUNDLE group is not created.

The procedures in this section are independent of the media type or "m=" line proto value represented by a bundled "m=" line. Section 10 defines additional considerations for RTP based media. Section 6 defines additional considerations for the usage of the SDP 'bundle-only' attribute. Section 11 defines additional considerations for the usage of Interactive Connectivity Establishment (ICE) [RFC5245] mechanism .

The offerer and answerer MUST follow the rules and restrictions defined in Section 7 when creating offers and answers.

SDP offers and answers can contain multiple BUNDLE groups. The procedures in this section apply independently to a given BUNDLE group.

8.2. Generating the Initial SDP Offer

8.2.1. General

When an offerer generates an initial offer, in order to create a BUNDLE group, it MUST:

- o Assign a unique address to each "m=" line within the offer, following the procedures in [RFC3264], unless the media line is a 'bundle-only' "m=" line (see below);
- o Add an SDP 'group:BUNDLE' attribute to the offer;
- o Place the identification-tag of each bundled "m=" line in the SDP 'group:BUNDLE' attribute identification-tag list; and
- o Indicate which unique address the offerer suggests as the offerer BUNDLE address [Section 8.2.2].

If the offerer wants to request that the answerer accepts a given bundled "m=" line only if the answerer keeps the "m=" line within the BUNDLE group, the offerer MUST:

- o Associate an SDP 'bundle-only' attribute [Section 8.2.2] with the "m=" line; and

- o Assign a zero port value to the "m=" line.

NOTE: If the offerer assigns a zero port value to an "m=" line, but does not also associate an SDP 'bundle-only' attribute with the "m=" line, it is an indication that the offerer wants to disable the "m=" line [Section 8.5.5].

[Section 16.1] shows an example of an initial offer.

8.2.2. Suggesting the offerer BUNDLE address

In the offer, the address assigned to the "m=" line associated with the offerer BUNDLE-tag indicates the address that the offerer suggests as the offerer BUNDLE address.

8.3. Generating the SDP Answer

8.3.1. General

When an answerer generates an answer, which contains a BUNDLE group, the following general SDP grouping framework restrictions, defined in [RFC5888], also apply to the BUNDLE group:

- o The answerer MUST NOT include a BUNDLE group in the answer, unless the offerer requested the BUNDLE group to be created in the associated offer; and
- o The answerer MUST NOT include an "m=" line within a BUNDLE group, unless the offerer requested the "m=" line to be within that BUNDLE group in the associated offer.

If the answer contains a BUNDLE group, the answerer MUST:

- o Select an Offerer BUNDLE Address [Section 8.3.2]; and
- o Select an Answerer BUNDLE Address [Section 8.3.3];

The answerer is allowed to select a new Answerer BUNDLE address each time it generates an answer to an offer.

If the answerer does not want to keep an "m=" line within a BUNDLE group, it MUST:

- o Move the "m=" line out of the BUNDLE group [Section 8.3.4]; or
- o Reject the "m=" line [Section 8.3.5];

If the answerer keeps a bundle-only "m=" line within the BUNDLE group, it follows the procedures (assigns the answerer BUNDLE address to the "m=" line etc) for any other "m=" line kept within the BUNDLE group.

If the answerer does not want to keep a bundle-only "m=" line within the BUNDLE group, it MUST reject the "m=" line [Section 8.3.5].

The answerer MUST NOT associate an SDP 'bundle-only' attribute with any "m=" line in an answer.

NOTE: If a bundled "m=" line in an offer contains a zero port value, but the "m=" line does not contain an SDP 'bundle-only' attribute, it is an indication that the offerer wants to disable the "m=" line [Section 8.5.5].

8.3.2. Answerer Selection of Offerer Bundle Address

In an offer, the address (unique or shared) assigned to the bundled "m=" line associated with the offerer BUNDLE-tag indicates the address that the offerer suggests as the offerer BUNDLE address [Section 8.2.2]. The answerer MUST check whether that "m=" line fulfills the following criteria:

- o The answerer will not move the "m=" line out of the BUNDLE group [Section 8.3.4];
- o The answerer will not reject the "m=" line [Section 8.3.5]; and
- o The "m=" line does not contain a zero port value.

If all of the criteria above are fulfilled, the answerer MUST select the address associated with the "m=" line as the offerer BUNDLE address. In the answer, the answerer BUNDLE-tag represents the "m=" line, and the address associated with the "m=" line in the offer becomes the offerer BUNDLE address.

If one or more of the criteria are not fulfilled, the answerer MUST select the next identification-tag in the identification-tag list, and perform the same criteria check for the "m=" line associated with that identification-tag. If there are no more identification-tags in the identification-tag list, the answerer MUST NOT create the BUNDLE group. In addition, unless the answerer rejects the whole offer, the answerer MUST apply the answerer procedures for moving an "m=" line out of a BUNDLE group [Section 8.3.4] to each bundled "m=" line in the offer when creating the answer.

[Section 16.1] shows an example of an offerer BUNDLE address selection.

8.3.3. Answerer Selection of Answerer BUNDLE Address

When the answerer selects a BUNDLE address for itself, referred to as the answerer BUNDLE address, it MUST assign that address to each bundled "m=" line within the created BUNDLE group in the answer.

The answerer MUST NOT assign the answerer BUNDLE address to an "m=" line that is not within the BUNDLE group, or to an "m=" line that is within another BUNDLE group.

[Section 16.1] shows an example of an answerer BUNDLE address selection.

8.3.4. Moving A Media Description Out Of A BUNDLE Group

When an answerer moves a "m=" line out of a BUNDLE group, it assigns an address to the "m=" line in the answer based on the following rules:

- o In the associated offer, if the "m=" line contains a shared address (e.g. a previously selected offerer BUNDLE address), the answerer MUST reject the moved "m=" line [Section 8.3.5];
- o In the associated offer, if the "m=" line contains a unique address, the answerer MUST assign a unique address also to the "m=" line in the answer; or
- o In the associated offer, if an SDP 'bundle-only' attribute is associated with the "m=" line, and if the "m=" line contains a zero port value, the answerer MUST reject the "m=" line [Section 8.3.5].

In addition, in either case above, the answerer MUST NOT place the identification-tag, associated with the moved "m=" line, in the SDP 'group' attribute identification-tag list associated with the BUNDLE group.

8.3.5. Rejecting A Media Description In A BUNDLE Group

When an answerer rejects an "m=" line, it MUST assign an address with a zero port value to the "m=" line in the answer, according to the procedures in [RFC4566].

In addition, the answerer MUST NOT place the identification-tag, associated with the rejected "m=" line, in the SDP 'group' attribute identification-tag list associated with the BUNDLE group.

8.4. Offerer Processing of the SDP Answer

8.4.1. General

When an offerer receives an answer, if the answer contains a BUNDLE group, the offerer MUST check that any bundled "m=" line in the answer was indicated as bundled in the associated offer. If there is no mismatch, the offerer MUST use the offerer BUNDLE address, selected by the answerer [Section 8.3.2], as the address for each bundled "m=" line.

NOTE: As the answerer might reject one or more bundled "m=" lines, or move a bundled "m=" line out of a BUNDLE group, each bundled "m=" line in the offer might not be indicated as bundled in the answer.

If the answer does not contain a BUNDLE group, the offerer MUST process the answer as a normal answer.

8.4.2. Bundle Address Synchronization (BAS)

When an offerer receives an answer, if the answer contains a BUNDLE group, the offerer MUST check whether the offerer BUNDLE address, selected by the answerer [Section 8.3.2], matches what was assigned to each bundled "m=" line (excluding any bundled "m=" line that was rejected, or moved out of the BUNDLE group, by the answerer) in the associated offer. If there is a mismatch, the offerer SHOULD as soon as possible generate a subsequent offer, in which it assigns the offerer BUNDLE address to each bundled "m=" line. Such offer is referred to as a Bundle Address Synchronization (BAS) offer.

A BAS offer is typically sent in the following scenarios:

- o The offerer receives an answer to an initial offer, as the bundled "m=" lines in the initial offer always contain unique addresses [Section 8.2]; or
- o The offerer receives an answer to an offer, in which a new bundled "m=" line has been added to the BUNDLE group [Section 8.5.3], and the offerer assigned a unique address to the bundled "m=" line in the offer.

The offerer is allowed to modify any SDP parameter in the BAS offer.

NOTE: It is important that the BAS offer gets accepted by the answerer. For that reason the offerer needs to consider the necessity to modify SDP parameters in the BAS offer, in such a way that could trigger the answerer to reject the BAS offer. Disabling "m=" lines, or reducing the number of codecs, in a BAS offer is considered to have a low risk of being rejected.

NOTE: The main purpose of the BAS offer is to ensure that intermediaries, that might not support the BUNDLE extension, have correct information regarding the address that is going to be used to transport the bundled media.

[Section 16.1] shows an example of a BAS offer.

8.5. Modifying the Session

8.5.1. General

When an offerer generates a subsequent offer, it MUST assign the previously selected offerer BUNDLE address [Section 8.3.2], to each bundled "m=" line (including any bundle-only "m=" line), except if:

- o The offerer suggests a new offerer BUNDLE address [Section 8.5.2];
- o The offerer wants to add a bundled "m=" line to the BUNDLE group [Section 8.5.3];
- o The offerer wants to move a bundled "m=" line out of the BUNDLE group [Section 8.5.4]; or
- o The offerer wants to disable the bundled "m=" line [Section 8.5.5].

In addition, the offerer MUST select an offerer BUNDLE-tag [Section 8.2.2] associated with the previously selected offerer BUNDLE address, unless the offerer suggests a new offerer BUNDLE address.

8.5.2. Suggesting a new offerer BUNDLE address

When an offerer generates an offer, in which it suggests a new offerer BUNDLE address [Section 8.2.2], the offerer MUST:

- o Assign the address (shared address) to each "m=" line within the BUNDLE group; or
- o Assign the address (unique address) to one bundled "m=" line.

NOTE: If the offerer assigns a unique address, there might be a need to send a subsequent BAS offer [Section 8.4.2] once the offerer has received the associated answer.

In addition, the offerer MUST indicate that the address is the new suggested offerer BUNDLE address [Section 8.2.2].

NOTE: Unless the offerer assigns the new suggested offerer BUNDLE address to each bundled "m=" line, it can assign unique addresses to any number of bundled "m=" lines (and the previously selected offerer BUNDLE address to any remaining bundled "m=" line) if it wants to suggest multiple alternatives for the new offerer BUNDLE address.

8.5.3. Adding a media description to a BUNDLE group

When an offerer generates an offer, in which it wants to add a bundled "m=" line to a BUNDLE group, the offerer MUST:

- o Assign a unique address to the "m=" line;
- o Assign the previously selected offerer BUNDLE address to the "m=" line; or
- o If the offerer assigns a new (shared address) suggested offerer BUNDLE address to each bundled "m=" line [Section 8.5.2], also assign that address to the added "m=" line.

In addition, the offerer MUST extend the SDP 'group:BUNDLE' attribute identification-tag list with the BUNDLE group [Section 8.2.2] by adding the identification-tag associated with the added "m=" line to the list.

NOTE: Assigning a unique address to the "m=" line allows the answerer to move the "m=" line out of the BUNDLE group [Section 8.3.4], without having to reject the "m=" line.

If the offerer assigns a unique address to the added "m=" line, and if the offerer suggests that address as the new offerer BUNDLE address [Section 8.5.2], the offerer BUNDLE-tag MUST represent the added "m=" line [Section 8.2.2].

If the offerer assigns a new suggested offerer BUNDLE address to each bundled "m=" line [Section 8.5.2], including the added "m=" line, the offerer BUNDLE-tag MAY represent the added "m=" line [Section 8.2.2].

[Section 16.3] shows an example where an offerer sends an offer in order to add a bundled "m=" line to a BUNDLE group.

8.5.4. Moving A Media Description Out Of A BUNDLE Group

When an offerer generates an offer, in which it wants to move a bundled "m=" line out of a BUNDLE group it was added to in a previous offer/answer transaction, the offerer:

- o MUST assign a unique address to the "m=" line; and
- o MUST NOT place the identification-tag associated with the "m=" line in the SDP 'group:BUNDLE' attribute identification-tag list associated with the BUNDLE group.

NOTE: If an "m=" line, when being moved out of a BUNDLE group, is added to another BUNDLE group, the offerer applies the procedures in [Section 8.5.3] to the "m=" line.

[Section 16.4] shows an example of an offer for moving an "m=" line out of a BUNDLE group.

8.5.5. Disabling A Media Description In A BUNDLE Group

When an offerer generates an offer, in which it wants to disable a bundled "m=" line (added to the BUNDLE group in a previous offer/answer transaction), the offerer:

- o MUST assign an address with a zero port value to the "m=" line, following the procedures in [RFC4566]; and
- o MUST NOT place the identification-tag associated with the "m=" line in the SDP 'group:BUNDLE' attribute identification-tag list associated with the BUNDLE group.

[Section 16.5] shows an example of an offer for disabling an "m=" line within a BUNDLE group.

9. Protocol Identification

9.1. General

Each "m=" line within a BUNDLE group MUST use the same transport-layer protocol. If bundled "m=" lines use different protocols on top of the transport-layer protocol, there MUST exist a publicly available specification which describes a mechanism, for this particular protocol combination, how to associate a received packet with the correct protocol.

In addition, if a received packet can be associated with more than one bundled "m=" line, there MUST exist a publically available

specification which describes a mechanism for associating the received packet with the correct "m=" line.

9.2. STUN, DTLS, SRTP

Section 5.1.2 of [RFC5764] describes a mechanism to identify the protocol of a received packet among the STUN, DTLS and SRTP protocols (in any combination). If an offer or answer includes bundled "m=" lines that represent these protocols, the offerer or answerer MUST support the mechanism described in [RFC5764], and no explicit negotiation is required in order to indicate support and usage of the mechanism.

[RFC5764] does not describe how to identify different protocols transported on DTLS, only how to identify the DTLS protocol itself. If multiple protocols are transported on DTLS, there MUST exist a specification describing a mechanism for identifying each individual protocol. In addition, if a received DTLS packet can be associated with more than one "m=" line, there MUST exist a specification which describes a mechanism for associating the received DTLS packet with the correct "m=" line.

[Section 10.2] describes how to associate a received (S)RTP packet with the correct "m=" line.

10. RTP Considerations

10.1. Single RTP Session

10.1.1. General

All RTP-based media within a single BUNDLE group belong to a single RTP session [RFC3550]. Disjoint BUNDLE groups will form multiple RTP sessions, one per BUNDLE group.

Since a single RTP session is used for each bundle group, all "m=" lines representing RTP-based media in a bundle group will share a single SSRC numbering space [RFC3550].

The following rules and restrictions apply for a single RTP session:

- o A specific payload type value can be used in multiple bundled "m=" lines if each codec associated with the payload type number shares an identical codec configuration [Section 10.1.2].
- o The proto value in each bundled RTP-based "m=" line MUST be identical (e.g. RTP/AVPF).

- o The RTP MID header extension MUST be enabled, by associating an SDP 'extmap' attribute [RFC5285], with a 'urn:ietf:params:rtp-hdext:sdes:mid' URI value, with each bundled RTP-based "m=" line in every offer and answer.
- o A given SSRC MUST NOT transmit RTP packets using payload types that originate from different bundled "m=" lines.

NOTE: The last bullet above is to avoid sending multiple media types from the same SSRC. If transmission of multiple media types are done with time overlap, RTP and RTCP fail to function. Even if done in proper sequence this causes RTP Timestamp rate switching issues [RFC7160]. However, once an SSRC has left the RTP session (by sending an RTCP BYE packet), that SSRC value can later be reused by another source (possible associated with a different bundled "m=" line).

10.1.2. Payload Type (PT) Value Reuse

Multiple bundled "m=" lines might represent RTP based media. As all RTP based media associated with a BUNDLE group belong to the same RTP session, in order for a given payload type value to be used inside more than one bundled "m=" line, all codecs associated with the payload type number MUST share an identical codec configuration. This means that the codecs MUST share the same media type, encoding name, clock rate and any parameter that can affect the codec configuration and packetization. [I-D.mmusic-sdp-mux-attributes] lists SDP attributes, whose attribute values must be identical for all codecs that use the same payload type value.

10.2. Associating RTP/RTCP Packets With Correct SDP Media Description

There are multiple mechanisms that can be used by an endpoint in order to associate received RTP/RTCP packets with a bundled "m=" line. Such mechanisms include using the payload type value carried inside the RTP packets, the SSRC values carried inside the RTP packets, and other "m=" line specific information carried inside the RTP packets.

As all RTP/RTCP packets associated with a BUNDLE group are received (and sent) using single address:port combinations, the local address:port combination cannot be used to associate received RTP packets with the correct "m=" line.

As described in [Section 10.1.2], the same payload type value might be used inside RTP packets described by multiple "m=" lines. In such cases, the payload type value cannot be used to associate received RTP packets with the correct "m=" line.

An offerer and answerer can in an offer and answer inform each other which SSRC values they will use inside sent RTP/RTCP packets, by associating one or more SDP 'ssrc' attributes [RFC5576] with each bundled "m=" line which contains a payload type value that is also used inside another bundled "m=" line. As the SSRC values will be carried inside the RTP/RTCP packets, the offerer and answerer can then use that information to associate received RTP packets with the correct "m=" line. However, an offerer will not know which SSRC values the answerer will use until it has received the answer providing that information. Due to this, before the offerer has received the answer, the offerer will not be able to associate received RTP/RTCP packets with the correct "m=" line using the SSRC values.

In order for an offerer and answerer to always be able to associate received RTP and RTCP packets with the correct "m=" line, an offerer and answerer using the BUNDLE extension MUST support the mechanism defined in Section 13, where the remote endpoint inserts the identification-tag associated with an "m=" line in RTP and RTCP packets associated with that "m=" line.

10.3. RTP/RTCP Multiplexing

10.3.1. General

When a BUNDLE group, which contains RTP based media, is created, the offerer and answerer MUST negotiate whether to enable RTP/RTCP multiplexing for the RTP based media associated with the BUNDLE group [RFC5761].

If RTP/RTCP multiplexing is not enabled, separate address:port combinations will be used for receiving (and sending) the RTP packets and the RTCP packets.

10.3.2. SDP Offer/Answer Procedures

10.3.2.1. General

This section describes how an offerer and answerer can use the SDP 'rtcp-mux' attribute [RFC5761] and the SDP 'rtcp' attribute [RFC3605] to negotiate usage of RTP/RTCP multiplexing for RTP based media associated with a BUNDLE group.

10.3.2.2. Generating the Initial SDP Offer

When an offerer generates an initial offer, if the offerer wants to negotiate usage of RTP/RTCP multiplexing within a BUNDLE group, the offerer MUST associate an SDP 'rtcp-mux' attribute [RFC5761] with

each bundled RTP-based "m=" line (including any bundle-only "m=" line) in the offer.

If the offerer does not want to negotiate usage of RTP/RTCP multiplexing, it MUST NOT associate an SDP 'rtcp-mux' attribute with any bundled "m=" line in the offer.

In addition, the offerer can associate an SDP 'rtcp' attribute [RFC3605] with one or more bundled RTP-based "m=" lines (including any bundle-only "m=" line) in the offer, in order to provide a port for receiving RTCP packets (if the answerer does not accept usage of RTP/RTCP multiplexing, or if the offerer does not want to negotiate usage of RTP/RTCP multiplexing).

In the initial offer, the IP address and port combination for RTCP MUST be unique in each bundled RTP-based "m=" line, similar to RTP.

NOTE: In case the offer wants to receive RTCP packets on the next higher port value, the SDP 'rtcp' attribute is not needed.

10.3.2.3. Generating the SDP Answer

When an answerer generates an answer, if the offerer indicated support of RTP/RTCP multiplexing [RFC5761] within a BUNDLE group in the associated offer, the answerer MUST either accept or reject the usage of RTP/RTCP multiplexing for the whole BUNDLE group in the answer.

If the answerer accepts the usage of RTP/RTCP multiplexing within the BUNDLE group, it MUST associate an SDP 'rtcp-mux' attribute with each bundled RTP-based "m=" line in the answer. The answerer MUST NOT associate an SDP 'rtcp' attribute with any bundled "m=" line in the answer. The answerer will use the port value of the selected offerer BUNDLE address for sending RTP and RTCP packets associated with each RTP-based bundled "m=" line towards the offerer.

If the answerer does not accept the usage of RTP/RTCP multiplexing within the BUNDLE group, it MUST NOT associate an SDP 'rtcp-mux' attribute with any bundled "m=" line in the answer. The answerer will use the RTP and RTCP port values associated with the selected offerer BUNDLE address for sending RTP and RTCP packets associated with each RTP-based bundled "m=" line towards the offerer.

In addition, if the answerer rejects the usage of RTP/RTCP multiplexing within the BUNDLE group, it MAY associate an SDP 'rtcp' attribute, with identical attribute values, with each RTP-based bundled "m=" line in the answer, in order to provide a port value for receiving RTCP packets from the offerer.

NOTE: In case the answerer wants to receive RTCP packets on the next higher port value, the SDP 'rtcp' attribute is not needed.

If the usage of RTP/RTCP multiplexing within a BUNDLE group has been negotiated in a previous offer/answer transaction, and if the offerer indicates that it wants to continue using RTP/RTCP multiplexing in a subsequent offer, the answerer MUST associate an SDP 'rtcp-mux' attribute with each bundled "m=" line in the answer. I.e. the answerer MUST NOT disable the usage of RTP/RTCP multiplexing.

If the usage of RTP/RTCP multiplexing within a BUNDLE group has not been negotiated in a previous offer/answer transaction, and if the offerer indicates that it wants to use RTP/RTCP multiplexing in a subsequent offer, the answerer either accepts or rejects the usage, using the procedures above.

10.3.2.4. Offerer Processing of the SDP Answer

When an offerer receives an answer, if the answerer has accepted the usage of RTP/RTCP multiplexing (see Section 10.3.2.3), the answerer follows the procedures for RTP/RTCP multiplexing defined in [RFC5761]. The offerer will use the port value associated with the answerer BUNDLE address for sending RTP and RTCP packets associated with each RTP-based bundled "m=" line towards the answerer.

If the answerer did not accept the usage of RTP/RTCP multiplexing (see Section 10.3.2.3), the offerer will use separate address:port combinations for sending RTP and RTCP packets towards the answerer. If the answerer associated an SDP 'rtcp' attribute with the "m=" line representing the answerer BUNDLE address, the offerer will use the attribute port value for sending RTCP packets associated with each bundled RTP-based "m=" line towards the answerer. Otherwise the offerer will use the next higher port value associated with the answerer BUNDLE address for sending RTCP packets towards the answerer.

10.3.2.5. Modifying the Session

When an offerer generates a subsequent offer, if it wants to negotiate the usage of RTP/RTCP multiplexing within a BUNDLE group, or if it wants to continue the use of previously negotiated RTP/RTCP multiplexing, it MUST associate an SDP 'rtcp-mux' attribute with each RTP-based bundled "m=" line (including any bundled "m=" line that the offerer wants to add to the BUNDLE group), unless the offerer wants to disable or remove the "m=" line from the BUNDLE group.

If the offerer does not want to negotiate the usage of RTP/RTCP multiplexing within the BUNDLE group, or if it wants to disable

previously negotiated usage of RTP/RTCP multiplexing, it MUST NOT associate an SDP 'rtcp-mux' attribute with any bundled "m=" line in the subsequent offer.

In addition, if the offerer does not indicate support of RTP/RTCP multiplexing within the subsequent offer, it MAY associate an SDP 'rtcp' attribute, with identical attribute values, with each RTP-based bundled "m=" line (including any bundled "m=" line that the offerer wants to add to the BUNDLE group), in order to provide a port for receiving RTCP packets.

NOTE: It is RECOMMENDED that, once the usage of RTP/RTCP multiplexing has been negotiated within a BUNDLE group, that the usage is not disabled. Disabling RTP/RTCP multiplexing means that the offerer and answerer need to reserve new ports, to be used for sending and receiving RTCP packets. Similar, if the usage of a specific RTCP port has been negotiated within a BUNDLE group, it is RECOMMENDED that the port value is not modified.

11. ICE Considerations

11.1. General

This section describes how to use the BUNDLE grouping extension together with the Interactive Connectivity Establishment (ICE) mechanism [RFC5245].

The procedures defined in [RFC5245] also apply to usage of ICE with BUNDLE, with the following exception:

- o When BUNDLE addresses for a BUNDLE group have been selected for both endpoints, ICE connectivity checks and keep-alives only need to be performed for the whole BUNDLE group, instead of per bundled "m=" line.

Support and usage of ICE mechanism together with the BUNDLE extension is OPTIONAL.

11.2. SDP Offer/Answer Procedures

11.2.1. General

When an offerer assigns a unique address to a bundled "m=" line (excluding any bundle-only "m=" line), it MUST also associate unique ICE candidates [RFC5245] to the "m=" line.

An offerer MUST NOT assign ICE candidates to a bundle-only "m=" line with a zero port value.

NOTE: The bundle-only "m=" line, if accepted by the answerer, will inherit the candidates associated with the selected offerer BUNDLE address. An answerer that does not support BUNDLE would not accept a bundle-only "m=" line.

When an offerer or answerer assigns a shared address (i.e. a previously selected BUNDLE address) to one or more bundled "m=" lines, it MUST associate identical ICE candidates (referred to as shared ICE candidates) to each of those "m=" lines.

11.2.2. Generating the Initial SDP Offer

When an offerer generates an initial offer, it assigns unique or shared ICE candidates to the bundled "m=" lines, according to Section 11.1.

11.2.3. Generating the SDP Answer

When an answerer generates an answer, which contains a BUNDLE group, the answerer MUST assign shared ICE candidates to each bundled "m=" line (including "m=" lines that were indicated as bundle-only in the associated offer) in the answer.

11.2.4. Offerer Processing of the SDP Answer

When an offerer receives an answer, if the answerer supports and uses the ICE mechanism and the BUNDLE extension, the offerer MUST assign the same ICE candidates, associated with the "m=" line representing the offerer BUNDLE address (selected by the answerer), to each bundled "m=" line.

11.2.5. Modifying the Session

When an offerer generates a subsequent offer, it assigns unique or shared ICE candidates to the bundled "m=" lines, according to (Section 11.1).

12. Update to RFC 3264

12.1. General

This section replaces the text of the following sections of RFC 3264:

- o Section 5.1 (Unicast Streams).
- o Section 8.2 (Removing a Media Stream).
- o Section 8.4 (Putting a Unicast Media Stream on Hold).

12.2. Original text of section 5.1 (2nd paragraph) of RFC 3264

For `recvonly` and `sendrecv` streams, the port number and address in the offer indicate where the offerer would like to receive the media stream. For `sendonly` RTP streams, the address and port number indirectly indicate where the offerer wants to receive RTCP reports. Unless there is an explicit indication otherwise, reports are sent to the port number one higher than the number indicated. The IP address and port present in the offer indicate nothing about the source IP address and source port of RTP and RTCP packets that will be sent by the offerer. A port number of zero in the offer indicates that the stream is offered but **MUST NOT** be used. This has no useful semantics in an initial offer, but is allowed for reasons of completeness, since the answer can contain a zero port indicating a rejected stream (Section 6). Furthermore, existing streams can be terminated by setting the port to zero (Section 8). In general, a port number of zero indicates that the media stream is not wanted.

12.3. New text replacing section 5.1 (2nd paragraph) of RFC 3264

For `recvonly` and `sendrecv` streams, the port number and address in the offer indicate where the offerer would like to receive the media stream. For `sendonly` RTP streams, the address and port number indirectly indicate where the offerer wants to receive RTCP reports. Unless there is an explicit indication otherwise, reports are sent to the port number one higher than the number indicated. The IP address and port present in the offer indicate nothing about the source IP address and source port of RTP and RTCP packets that will be sent by the offerer. A port number of zero in the offer by default indicates that the stream is offered but **MUST NOT** be used, but an extension mechanism might specify different semantics for the usage of a zero port value. Furthermore, existing streams can be terminated by setting the port to zero (Section 8). In general, a port number of zero by default indicates that the media stream is not wanted.

12.4. Original text of section 8.2 (2nd paragraph) of RFC 3264

A stream that is offered with a port of zero **MUST** be marked with port zero in the answer. Like the offer, the answer **MAY** omit all attributes present previously, and **MAY** list just a single media format from amongst those in the offer.

12.5. New text replacing section 8.2 (2nd paragraph) of RFC 3264

A stream that is offered with a port of zero **MUST** by default be marked with port zero in the answer, unless an extension mechanism, which specifies semantics for the usage of a non-zero port value, is used. If the stream is marked with port zero in the answer, the

answer MAY omit all attributes present previously, and MAY list just a single media format from amongst those in the offer."

12.6. Original text of section 8.4 (6th paragraph) of RFC 3264

RFC 2543 [10] specified that placing a user on hold was accomplished by setting the connection address to 0.0.0.0. Its usage for putting a call on hold is no longer recommended, since it doesn't allow for RTCP to be used with held streams, doesn't work with IPv6, and breaks with connection oriented media. However, it can be useful in an initial offer when the offerer knows it wants to use a particular set of media streams and formats, but doesn't know the addresses and ports at the time of the offer. Of course, when used, the port number MUST NOT be zero, which would specify that the stream has been disabled. An agent MUST be capable of receiving SDP with a connection address of 0.0.0.0, in which case it means that neither RTP nor RTCP should be sent to the peer.

12.7. New text replacing section 8.4 (6th paragraph) of RFC 3264

RFC 2543 [10] specified that placing a user on hold was accomplished by setting the connection address to 0.0.0.0. Its usage for putting a call on hold is no longer recommended, since it doesn't allow for RTCP to be used with held streams, doesn't work with IPv6, and breaks with connection oriented media. However, it can be useful in an initial offer when the offerer knows it wants to use a particular set of media streams and formats, but doesn't know the addresses and ports at the time of the offer. Of course, when used, the port number MUST NOT be zero, if it would specify that the stream has been disabled. However, an extension mechanism might specify different semantics of the zero port number usage. An agent MUST be capable of receiving SDP with a connection address of 0.0.0.0, in which case it means that neither RTP nor RTCP should be sent to the peer.

13. RTP/RTCP extensions for identification-tag transport

13.1. General

SDP Offerers and Answerers [RFC3264] can associate identification-tags with "m=" lines within SDP Offers and Answers, using the procedures in [RFC5888]. Each identification-tag uniquely represents an "m=" line.

This section defines a new RTCP SDES item [RFC3550], 'MID', which is used to carry identification-tags within RTCP SDES packets. This section also defines a new RTP header extension [RFC5285], which is used to carry identification-tags in RTP packets.

The SDDES item and RTP header extension make it possible for a receiver to associate received RTCP- and RTP packets with a specific "m=" line, to which the receiver has assigned an identification-tag, even if those "m=" lines are part of the same RTP session. The endpoint informs the remote endpoint about the identification-tag using the procedures in [RFC5888], and the remote endpoint then inserts the identification-tag in RTCP- and RTP packets sent towards the other endpoint.

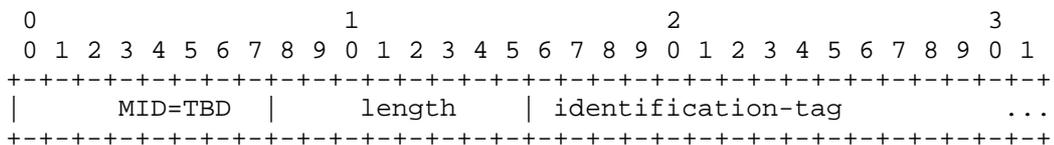
NOTE: This text above defines how identification-tags are carried in SDP Offers and Answers. The usage of other signalling protocols for carrying identification-tags is not prevented, but the usage of such protocols is outside the scope of this document.

[RFC3550] defines general procedures regarding the RTCP transmission interval. The RTCP MID SDDES item SHOULD be sent in the first few RTCP packets sent on joining the session, and SHOULD be sent regularly thereafter. The exact number of RTCP packets in which this SDDES item is sent is intentionally not specified here, as it will depend on the expected packet loss rate, the RTCP reporting interval, and the allowable overhead.

The RTP MID header extension SHOULD be included in some RTP packets at the start of the session and whenever the SSRC changes. It might also be useful to include the header extension in RTP packets that comprise random access points in the media (e.g., with video I-frames). The exact number of RTP packets in which this header extension is sent is intentionally not specified here, as it will depend on expected packet loss rate and loss patterns, the overhead the application can tolerate, and the importance of immediate receipt of the identification-tag.

For robustness purpose, endpoints need to be prepared for situations where the reception of the identification-tag is delayed, and SHOULD NOT terminate sessions in such cases, as the identification-tag is likely to arrive soon.

13.2. RTCP MID SDDES Item



The identification-tag payload is UTF-8 encoded, as in SDP.

The identification-tag is not zero terminated.

[RFC EDITOR NOTE: Please replace TBD with the assigned SDDES identifier value.]

13.3. RTP MID Header Extension

The payload, containing the identification-tag, of the RTP MID header extension element can be encoded using either the one-byte or two-byte header [RFC5285]. The identification-tag payload is UTF-8 encoded, as in SDP.

The identification-tag is not zero terminated. Note, that set of header extensions included in the packet needs to be padded to the next 32-bit boundary using zero bytes [RFC5285].

As the identification-tag is included in either an RTCP SDDES item or an RTP header extension, or both, there should be some consideration about the packet expansion caused by the identification-tag. To avoid Maximum Transmission Unit (MTU) issues for the RTP packets, the header extension's size needs to be taken into account when the encoding media.

It is recommended that the identification-tag is kept short. Due to the properties of the RTP header extension mechanism, when using the one-byte header, a tag that is 1-3 bytes will result in that a minimal number of 32-bit words are used for the RTP header extension, in case no other header extensions are included at the same time. Note, do take into account that some single characters when UTF-8 encoded will result in multiple octets.

14. IANA Considerations

14.1. New SDDES item

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

[RFC EDITOR NOTE: Please replace TBD with the assigned SDDES identifier value.]

This document adds the MID SDDES item to the IANA "RTCP SDDES item types" registry as follows:

Value: TBD
Abbrev.: MID
Name: Media Identification
Reference: RFCXXXX

14.2. New RTP Header Extension URI

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

This document defines a new extension URI in the RTP Compact Header Extensions subregistry of the Real-Time Transport Protocol (RTP) Parameters registry, according to the following data:

Extension URI: urn:ietf:params:rtp-hdext:sdes:mid
Description: Media identification
Contact: christer.holmberg@ericsson.com
Reference: RFCXXXX

14.3. New SDP Attribute

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

This document defines a new SDP media-level attribute, 'bundle-only', according to the following data:

Attribute name: bundle-only
Type of attribute: media
Subject to charset: No
Purpose: Request a media description to be accepted
in the answer only if kept within a BUNDLE
group by the answerer.
Appropriate values: N/A
Contact name: Christer Holmberg
Contact e-mail: christer.holmberg@ericsson.com
Reference: RFCXXXX

15. Security Considerations

The security considerations defined in [RFC3264] and [RFC5888] apply to the BUNDLE extension. Bundle does not change which information flows over the network but only changes which ports that information

is flowing on and thus has very little impact on the security of the RTP sessions.

When the BUNDLE extension is used, a single set of security credentials might be used for all media streams associated with a BUNDLE group.

When the BUNDLE extension is used, the number of SSRC values within a single RTP session increases, which increases the risk of SSRC collision. [RFC4568] describes how SSRC collision may weaken SRTP and SRTCP encryption in certain situations.

16. Examples

16.1. Example: Bundle Address Selection

The example below shows:

- o 1. An offer, in which the offerer assigns a unique address to each bundled "m=" line within the BUNDLE group.
- o 2. An answer, in which the answerer selects the offerer BUNDLE address, and in which selects its own BUNDLE address (the answerer BUNDLE address) and assigns it each bundled "m=" line within the BUNDLE group.
- o 3. A subsequent offer (BAS offer), which is used to perform a Bundle Address Synchronization (BAS).

SDP Offer (1)

```
v=0
o=alice 2890844526 2890844526 IN IP4 atlanta.example.com
s=
c=IN IP4 atlanta.example.com
t=0 0
a=group:BUNDLE foo bar
m=audio 10000 RTP/AVP 0 8 97
b=AS:200
a=mid:foo
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
a=rtpmap:97 iLBC/8000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 10002 RTP/AVP 31 32
b=AS:1000
a=mid:bar
```

```
a=rtpmap:31 H261/90000
a=rtpmap:32 MPV/90000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
```

SDP Answer (2)

```
v=0
o=bob 2808844564 2808844564 IN IP4 biloxi.example.com
s=
c=IN IP4 biloxi.example.com
t=0 0
a=group:BUNDLE foo bar
m=audio 20000 RTP/AVP 0
b=AS:200
a=mid:foo
a=rtpmap:0 PCMU/8000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 20000 RTP/AVP 32
b=AS:1000
a=mid:bar
a=rtpmap:32 MPV/90000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
```

SDP Offer (3)

```
v=0
o=alice 2890844526 2890844526 IN IP4 atlanta.example.com
s=
c=IN IP4 atlanta.example.com
t=0 0
a=group:BUNDLE foo bar
m=audio 10000 RTP/AVP 0 8 97
b=AS:200
a=mid:foo
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
a=rtpmap:97 iLBC/8000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 10000 RTP/AVP 31 32
b=AS:1000
a=mid:bar
a=rtpmap:31 H261/90000
a=rtpmap:32 MPV/90000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
```

16.2. Example: BUNDLE Extension Rejected

The example below shows:

- o 1. An offer, in which the offerer assigns a unique address to each bundled "m=" line within the BUNDLE group.
- o 2. An answer, in which the answerer rejects the offered BUNDLE group, and assigns a unique addresses to each "m=" line (following normal RFC 3264 procedures).

SDP Offer (1)

```
v=0
o=alice 2890844526 2890844526 IN IP4 atlanta.example.com
s=
c=IN IP4 atlanta.example.com
t=0 0
a=group:BUNDLE foo bar
m=audio 10000 RTP/AVP 0 8 97
b=AS:200
a=mid:foo
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
a=rtpmap:97 iLBC/8000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 10002 RTP/AVP 31 32
b=AS:1000
a=mid:bar
a=rtpmap:31 H261/90000
a=rtpmap:32 MPV/90000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
```

SDP Answer (2)

```
v=0
o=bob 2808844564 2808844564 IN IP4 biloxi.example.com
s=
c=IN IP4 biloxi.example.com
t=0 0
m=audio 20000 RTP/AVP 0
b=AS:200
a=rtpmap:0 PCMU/8000
m=video 30000 RTP/AVP 32
b=AS:1000
a=rtpmap:32 MPV/90000
```

16.3. Example: Offerer Adds A Media Description To A BUNDLE Group

The example below shows:

- o 1. A subsequent offer (the BUNDLE group has been created as part of a previous offer/answer transaction), in which the offerer adds a new "m=" line, represented by the "zen" identification-tag, to a previously negotiated BUNDLE group, assigns a unique address to the added "m=" line, and assigns the previously selected offerer

BUNDLE address to each of the other bundled "m=" lines within the BUNDLE group.

- o 2. An answer, in which the answerer assigns the answerer BUNDLE address to each bundled "m=" line (including the newly added "m=" line) within the BUNDLE group.
- o 3. A subsequent offer (BAS offer), which is used to perform a Bundle Address Synchronization (BAS).

SDP Offer (1)

```
v=0
o=alice 2890844526 2890844526 IN IP4 atlanta.example.com
s=
c=IN IP4 atlanta.example.com
t=0 0
a=group:BUNDLE foo bar zen
m=audio 10000 RTP/AVP 0 8 97
b=AS:200
a=mid:foo
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
a=rtpmap:97 iLBC/8000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 10000 RTP/AVP 31 32
b=AS:1000
a=mid:bar
a=rtpmap:31 H261/90000
a=rtpmap:32 MPV/90000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 20000 RTP/AVP 66
b=AS:1000
a=mid:zen
a=rtpmap:66 H261/90000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
```

SDP Answer (2)

```
v=0
o=bob 2808844564 2808844564 IN IP4 biloxi.example.com
s=
c=IN IP4 biloxi.example.com
t=0 0
a=group:BUNDLE foo bar zen
m=audio 20000 RTP/AVP 0
```

```
b=AS:200
a=mid:foo
a=rtpmap:0 PCMU/8000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 20000 RTP/AVP 32
b=AS:1000
a=mid:bar
a=rtpmap:32 MPV/90000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 20000 RTP/AVP 66
b=AS:1000
a=mid:zen
a=rtpmap:66 H261/90000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
```

SDP Offer (3)

```
v=0
o=alice 2890844526 2890844526 IN IP4 atlanta.example.com
s=
c=IN IP4 atlanta.example.com
t=0 0
a=group:BUNDLE foo bar zen
m=audio 10000 RTP/AVP 0 8 97
b=AS:200
a=mid:foo
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
a=rtpmap:97 iLBC/8000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 10000 RTP/AVP 31 32
b=AS:1000
a=mid:bar
a=rtpmap:31 H261/90000
a=rtpmap:32 MPV/90000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 10000 RTP/AVP 66
b=AS:1000
a=mid:zen
a=rtpmap:66 H261/90000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
```

16.4. Example: Offerer Moves A Media Description Out Of A BUNDLE Group

The example below shows:

- o 1. A subsequent offer (the BUNDLE group has been created as part of a previous offer/answer transaction), in which the offerer moves a bundled "m=" line out of a BUNDLE group, assigns a unique address to the moved "m=" line, and assigns the offerer BUNDLE address to each other bundled "m=" line within the BUNDLE group.
- o 2. An answer, in which the answerer moves the "m=" line out of the BUNDLE group, assigns unique address to the moved "m=" line, and assigns the answerer BUNDLE address to each of the remaining bundled "m=" line within the BUNDLE group.

SDP Offer (1)

```
v=0
o=alice 2890844526 2890844526 IN IP4 atlanta.example.com
s=
c=IN IP4 atlanta.example.com
t=0 0
a=group:BUNDLE foo bar
m=audio 10000 RTP/AVP 0 8 97
b=AS:200
a=mid:foo
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
a=rtpmap:97 iLBC/8000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 10000 RTP/AVP 31 32
b=AS:1000
a=mid:bar
a=rtpmap:31 H261/90000
a=rtpmap:32 MPV/90000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 50000 RTP/AVP 66
b=AS:1000
a=mid:zen
a=rtpmap:66 H261/90000
```

SDP Answer (2)

```
v=0
o=bob 2808844564 2808844564 IN IP4 biloxi.example.com
s=
```

```
c=IN IP4 biloxi.example.com
t=0 0
a=group:BUNDLE foo bar
m=audio 20000 RTP/AVP 0
b=AS:200
a=mid:foo
a=rtpmap:0 PCMU/8000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 20000 RTP/AVP 32
b=AS:1000
a=mid:bar
a=rtpmap:32 MPV/90000
a=extmap 1 urn:ietf:params:rtp-hdext:sdes:mid
m=video 60000 RTP/AVP 66
b=AS:1000
a=mid:zen
a=rtpmap:66 H261/90000
```

16.5. Example: Offerer Disables A Media Description Within A BUNDLE Group

The example below shows:

- o 1. A subsequent offer (the BUNDLE group has been created as part of a previous offer/answer transaction), in which the offerer disables a bundled "m=" line within BUNDLE group, assigns a zero port number to the disabled "m=" line, and assigns the offerer BUNDLE address to each of the other bundled "m=" lines within the BUNDLE group.
- o 2. An answer, in which the answerer moves the disabled "m=" line out of the BUNDLE group, assigns a zero port value to the disabled "m=" line, and assigns the answerer BUNDLE address to each of the remaining bundled "m=" line within the BUNDLE group.

SDP Offer (1)

```
v=0
o=alice 2890844526 2890844526 IN IP4 atlanta.example.com
s=
c=IN IP4 atlanta.example.com
t=0 0
a=group:BUNDLE foo bar
m=audio 10000 RTP/AVP 0 8 97
b=AS:200
```

```
a=mid:foo
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
a=rtpmap:97 iLBC/8000
a=extmap 1 urn:ietf:params:rtp-hdrext:sdes:mid
m=video 10000 RTP/AVP 31 32
b=AS:1000
a=mid:bar
a=rtpmap:31 H261/90000
a=rtpmap:32 MPV/90000
a=extmap 1 urn:ietf:params:rtp-hdrext:sdes:mid
m=video 0 RTP/AVP 66
a=mid:zen
a=rtpmap:66 H261/90000
```

SDP Answer (2)

```
v=0
o=bob 2808844564 2808844564 IN IP4 biloxi.example.com
s=
c=IN IP4 biloxi.example.com
t=0 0
a=group:BUNDLE foo bar
m=audio 20000 RTP/AVP 0
b=AS:200
a=mid:foo
a=rtpmap:0 PCMU/8000
a=extmap 1 urn:ietf:params:rtp-hdrext:sdes:mid
m=video 20000 RTP/AVP 32
b=AS:1000
a=mid:bar
a=rtpmap:32 MPV/90000
a=extmap 1 urn:ietf:params:rtp-hdrext:sdes:mid
m=video 0 RTP/AVP 66
a=mid:zen
a=rtpmap:66 H261/90000
```

17. Acknowledgements

The usage of the SDP grouping extension for negotiating bundled media is based on a similar alternatives proposed by Harald Alvestrand and Cullen Jennings. The BUNDLE extension described in this document is based on the different alternative proposals, and text (e.g. SDP examples) have been borrowed (and, in some cases, modified) from those alternative proposals.

The SDP examples are also modified versions from the ones in the Alvestrand proposal.

Thanks to Paul Kyzivat, Martin Thomson, Flemming Andreassen, Thomas Stach and Ari Keraenen for taking the time to read the text along the way, and providing useful feedback.

18. Change Log

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

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-17

- o - Editorial changes based on comments from Magnus Westerlund.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-16

- o - Modification of RTP/RTCP multiplexing section, based on comments from Magnus Westerlund.
- o - Reference updates.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-15

- o - Editorial fix.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-14

- o - Editorial changes.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-13

- o Changes to allow a new suggested offerer BUNDLE address to be assigned to each bundled m- line.
- o Changes based on WGLC comments from Paul Kyzivat
- o - Editorial fixes

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-12

- o Usage of SDP 'extmap' attribute added
- o SDP 'bundle-only' attribute scoped with "m=" lines with a zero port value
- o Changes based on WGLC comments from Thomas Stach

- o - ICE candidates not assigned to bundle-only m- lines with a zero port value
- o - Editorial changes
- o Changes based on WGLC comments from Colin Perkins
- o - Editorial changes:
 - o -- "RTP SDES item" -> "RTCP SDES item"
 - o -- "RTP MID SDES item" -> "RTCP MID SDES item"
- o - Changes in section 10.1.1:
 - o -- "SHOULD NOT" -> "MUST NOT"
 - o -- Additional text added to the Note
- o - Change to section 13.2:
 - o -- Clarify that mid value is not zero terminated
- o - Change to section 13.3:
 - o -- Clarify that mid value is not zero terminated
 - o -- Clarify padding
- o Changes based on WGLC comments from Paul Kyzivat
- o - Editorial changes:
- o Changes based on WGLC comments from Jonathan Lennox
- o - Editorial changes:
 - o - Defintion of SDP bundle-only attribute aligned with structure in 4566bis draft

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-11

- o Editorial corrections based on comments from Harald Alvestrand.
- o Editorial corrections based on comments from Cullen Jennings.
- o Reference update (RFC 7160).

- o Clarification about RTCP packet sending when RTP/RTCP multiplexing is not used (<http://www.ietf.org/mail-archive/web/mmusic/current/msg13765.html>).

- o Additional text added to the Security Considerations.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-10

- o SDP bundle-only attribute added to IANA Considerations.
- o SDES item and RTP header extension added to Abstract and Introduction.
- o Modification to text updating section 8.2 of RFC 3264.
- o Reference corrections.
- o Editorial corrections.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-09

- o Terminology change: "bundle-only attribute assigned to m= line" to "bundle-only attribute associated with m= line".
- o Editorial corrections.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-08

- o Editorial corrections.
- o - "of"->"if" (8.3.2.5).
- o - "optional"->"OPTIONAL" (9.1).
- o - Syntax/ABNF for 'bundle-only' attribute added.
- o - SDP Offer/Answer sections merged.
- o - 'Request new offerer BUNDLE address' section added

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-07

- o OPEN ISSUE regarding Receiver-ID closed.
- o - RTP MID SDES Item.
- o - RTP MID Header Extension.

- o OPEN ISSUE regarding insertion of SDP 'rtcp' attribute in answers closed.
- o - Indicating that, when rtcp-mux is used, the answerer MUST NOT include an 'rtcp' attribute in the answer, based on the procedures in section 5.1.3 of RFC 5761.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-06

- o Draft title changed.
- o Added "SDP" to section names containing "Offer" or "Answer".
- o Editorial fixes based on comments from Paul Kyzivat (<http://www.ietf.org/mail-archive/web/mmusic/current/msg13314.html>).
- o Editorial fixed based on comments from Colin Perkins (<http://www.ietf.org/mail-archive/web/mmusic/current/msg13318.html>).
- o - Removed text about extending BUNDLE to allow multiple RTP sessions within a BUNDLE group.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-05

- o Major re-structure of SDP Offer/Answer sections, to align with RFC 3264 structure.
- o Additional definitions added.
- o - Shared address.
- o - Bundled "m=" line.
- o - Bundle-only "m=" line.
- o - Offerer suggested BUNDLE mid.
- o - Answerer selected BUNDLE mid.
- o Q6 Closed (IETF#88): An Offerer MUST NOT assign a shared address to multiple "m=" lines until it has received an SDP Answer indicating support of the BUNDLE extension.
- o Q8 Closed (IETF#88): An Offerer can, before it knows whether the Answerer supports the BUNDLE extension, assign a zero port value to a 'bundle-only' "m=" line.

- o SDP 'bundle-only' attribute section added.
- o Connection data nettype/addrtype restrictions added.
- o RFC 3264 update section added.
- o Indicating that a specific payload type value can be used in multiple "m=" lines, if the value represents the same codec configuration in each "m=" line.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-04

- o Updated Offerer procedures (<http://www.ietf.org/mail-archive/web/mmusic/current/msg12293.html>).
- o Updated Answerer procedures (<http://www.ietf.org/mail-archive/web/mmusic/current/msg12333.html>).
- o Usage of SDP 'bundle-only' attribute added.
- o Reference to Trickle ICE document added.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-02

- o Mechanism modified, to be based on usage of SDP Offers with both different and identical port number values, depending on whether it is known if the remote endpoint supports the extension.
- o Cullen Jennings added as co-author.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-01

- o No changes. New version due to expiration.

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-00

- o No changes. New version due to expiration.

Changes from draft-holmberg-mmusic-sdp-multiplex-negotiation-00

- o Draft name changed.
- o Harald Alvestrand added as co-author.
- o "Multiplex" terminology changed to "bundle".
- o Added text about single versus multiple RTP Sessions.

- o Added reference to RFC 3550.

19. References

19.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
- [RFC3264] Rosenberg, J. and H. Schulzrinne, "An Offer/Answer Model with Session Description Protocol (SDP)", RFC 3264, June 2002.
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- [RFC5285] Singer, D. and H. Desineni, "A General Mechanism for RTP Header Extensions", RFC 5285, July 2008.
- [RFC5761] Perkins, C. and M. Westerlund, "Multiplexing RTP Data and Control Packets on a Single Port", RFC 5761, April 2010.
- [RFC5888] Camarillo, G. and H. Schulzrinne, "The Session Description Protocol (SDP) Grouping Framework", RFC 5888, June 2010.
- [I-D.mmusic-sdp-mux-attributes] Nandakumar, S., "A Framework for SDP Attributes when Multiplexing", draft-ietf-mmusic-sdp-mux-attributes-08 (work in progress), January 2015.

19.2. Informative References

- [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.
- [RFC3550] Schulzrinne, H., Casner, S., Frederick, R., and V. Jacobson, "RTP: A Transport Protocol for Real-Time Applications", STD 64, RFC 3550, July 2003.
- [RFC3605] Huitema, C., "Real Time Control Protocol (RTCP) attribute in Session Description Protocol (SDP)", RFC 3605, October 2003.
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- [RFC5245] Rosenberg, J., "Interactive Connectivity Establishment (ICE): A Protocol for Network Address Translator (NAT) Traversal for Offer/Answer Protocols", RFC 5245, April 2010.
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- [RFC5764] McGrew, D. and E. Rescorla, "Datagram Transport Layer Security (DTLS) Extension to Establish Keys for the Secure Real-time Transport Protocol (SRTP)", RFC 5764, May 2010.
- [RFC7160] Petit-Huguenin, M. and G. Zorn, "Support for Multiple Clock Rates in an RTP Session", RFC 7160, April 2014.
- [I-D.ietf-mmusic-trickle-ice]
Ivov, E., Rescorla, E., and J. Uberti, "Trickle ICE: Incremental Provisioning of Candidates for the Interactive Connectivity Establishment (ICE) Protocol", draft-ietf-mmusic-trickle-ice-02 (work in progress), January 2015.

Appendix A. Design Considerations

A.1. General

One of the main issues regarding the BUNDLE grouping extensions has been whether, in SDP Offers and SDP Answers, the same port value should be inserted in "m=" lines associated with a BUNDLE group, as the purpose of the extension is to negotiate the usage of a single address:port combination for media associated with the "m=" lines. Issues with both approaches, discussed in the Appendix have been raised. The outcome was to specify a mechanism which uses SDP Offers with both different and identical port values.

Below are the primary issues that have been considered when defining the "BUNDLE" grouping extension:

- o 1) Interoperability with existing UAs.
- o 2) Interoperability with intermediary B2BUA- and proxy entities.
- o 3) Time to gather, and the number of, ICE candidates.
- o 4) Different error scenarios, and when they occur.
- o 5) SDP Offer/Answer impacts, including usage of port number value zero.

NOTE: Before this document is published as an RFC, this Appendix might be removed.

A.2. UA Interoperability

Consider the following SDP Offer/Answer exchange, where Alice sends an SDP Offer to Bob:

SDP Offer

```
v=0
o=alice 2890844526 2890844526 IN IP4 atlanta.example.com
s=
c=IN IP4 atlanta.example.com
t=0 0
m=audio 10000 RTP/AVP 97
a=rtpmap:97 iLBC/8000
m=video 10002 RTP/AVP 97
a=rtpmap:97 H261/90000
```

SDP Answer

```
v=0
o=bob 2808844564 2808844564 IN IP4 biloxi.example.com
s=
c=IN IP4 biloxi.example.com
t=0 0
m=audio 20000 RTP/AVP 97
a=rtpmap:97 iLBC/8000
m=video 20002 RTP/AVP 97
a=rtpmap:97 H261/90000
```

RFC 4961 specifies a way of doing symmetric RTP but that is an a later invention to RTP and Bob can not assume that Alice supports RFC 4961. This means that Alice may be sending RTP from a different port than 10000 or 10002 - some implementation simply send the RTP from an ephemeral port. When Bob's endpoint receives an RTP packet, the only way that Bob know if it should be passed to the video or audio codec is by looking at the port it was received on. This lead some SDP implementations to use the fact that each "m=" line had a different port number to use that port number as an index to find the correct m line in the SDP. As a result, some implementations that do support

symmetric RTP and ICE still use a SDP data structure where SDP with "m=" lines with the same port such as:

SDP Offer

```
v=0
o=alice 2890844526 2890844526 IN IP4 atlanta.example.com
s=
c=IN IP4 atlanta.example.com
t=0 0
m=audio 10000 RTP/AVP 97
a=rtpmap:97 iLBC/8000
m=video 10000 RTP/AVP 98
a=rtpmap:98 H261/90000
```

will result in the second "m=" line being considered an SDP error because it has the same port as the first line.

A.3. Usage of port number value zero

In an SDP Offer or SDP Answer, the media associated with an "m=" line can be disabled/rejected by setting the port number value to zero. This is different from e.g. using the SDP direction attributes, where RTCP traffic will continue even if the SDP "inactive" attribute is indicated for the associated "m=" line.

If each "m=" line associated with a BUNDLE group would contain different port values, and one of those port values would be used for a BUNDLE address associated with the BUNDLE group, problems would occur if an endpoint wants to disable/reject the "m=" line associated with that port, by setting the port value to zero. After that, no "m=" line would contain the port value which is used for the BUNDLE address. In addition, it is unclear what would happen to the ICE candidates associated with the "m=" line, as they are also used for the BUNDLE address.

A.4. B2BUA And Proxy Interoperability

Some back to back user agents may be configured in a mode where if the incoming call leg contains an SDP attribute the B2BUA does not understand, the B2BUS still generates that SDP attribute in the Offer for the outgoing call leg. Consider an B2BUA that did not understand the SDP "rtcp" attribute, defined in RFC 3605, yet acted this way. Further assume that the B2BUA was configured to tear down any call

where it did not see any RTCP for 5 minutes. In this cases, if the B2BUA received an Offer like:

SDP Offer

```
v=0
o=alice 2890844526 2890844526 IN IP4 atlanta.example.com
s=
c=IN IP4 atlanta.example.com
t=0 0
m=audio 49170 RTP/AVP 0
a=rtcp:53020
```

It would be looking for RTCP on port 49172 but would not see any because the RTCP would be on port 53020 and after five minutes, it would tear down the call. Similarly, an SBC that did not understand BUNDLE yet put BUNDLE in it's offer may be looking for media on the wrong port and tear down the call. It is worth noting that a B2BUA that generated an Offer with capabilities it does not understand is not compliant with the specifications.

A.4.1. Traffic Policing

Sometimes intermediaries do not act as B2BUA, in the sense that they don't modify SDP bodies, nor do they terminate SIP dialogs. Still, however, they may use SDP information (e.g. IP address and port) in order to control traffic gating functions, and to set traffic policing rules. There might be rules which will trigger a session to be terminated in case media is not sent or received on the ports retrieved from the SDP. This typically occurs once the session is already established and ongoing.

A.4.2. Bandwidth Allocation

Sometimes intermediaries do not act as B2BUA, in the sense that they don't modify SDP bodies, nor do they terminate SIP dialogs. Still, however, they may use SDP information (e.g. codecs and media types) in order to control bandwidth allocation functions. The bandwidth allocation is done per "m=" line, which means that it might not be enough if media associated with all "m=" lines try to use that bandwidth. That may either simply lead to bad user experience, or to termination of the call.

A.5. Candidate Gathering

When using ICE, an candidate needs to be gathered for each port. This takes approximately 20 ms extra for each extra "m=" line due to the NAT pacing requirements. All of this gather can be overlapped with other things while the page is loading to minimize the impact. If the client only wants to generate TURN or STUN ICE candidates for one of the "m=" lines and then use trickle ICE [I-D.ietf-mmusic-trickle-ice] to get the non host ICE candidates for the rest of the "m=" lines, it MAY do that and will not need any additional gathering time.

Some people have suggested a TURN extension to get a bunch of TURN allocation at once. This would only provide a single STUN result so in cases where the other end did not support BUNDLE, may cause more use of the TURN server but would be quick in the cases where both sides supported BUNDLE and would fall back to a successful call in the other cases.

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