Negotiating Media Multiplexing Using the Session Description Protocol (SDP)
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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.

   There are multiple ways to correlate the bundled RTP packets with the
   appropriate media descriptions. This specification defines a new
   Real-time Transport Protocol (RTP) source description (SDES) 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.

Status of This Memo

   This Internet-Draft will expire on December 18, 2015.

Table of Contents

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] source description (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

"m=" line: SDP bodies contain one or more media descriptions. Each
media description is identified by an SDP "m=" line.

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 an 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 [RFC4961] is used.

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 support 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 the offerer BUNDLE address has been selected, the offerer does not need to include the 'bundle-only' attribute in subsequent offers. By assigning the offerer BUNDLE address to an "m=" line of a subsequent offer, the offerer will ensure that the answerer will either keep the "m=" line within the BUNDLE group, or the answerer will have to reject the "m=" line.

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=)

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

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 .

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 17.1] 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 that 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 17.1] 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 17.1] shows an example of an answerer BUNDLE address
selection.

8.3.4. Moving A Media Description Out Of A BUNDLE Group

When an answerer wants to move an "m=" line out of a BUNDLE group, it
MUST first check the following criteria:

o In the associated offer, the "m=" line contains a shared address
   (e.g. a previously selected offerer BUNDLE address); 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.

If either criteria above is fulfilled, the answerer MUST reject the
"m=" line [Section 8.3.5].

Otherwise, if in the associated offer the "m=" line contains a unique
address, the answerer MUST assign a unique address to the "m=" line
in the answer (the answerer does not reject the "m=" line).

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

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.

8.5. 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.

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 17.3] 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 the removed "m=" line is associated with the previously
   selected BUNDLE-tag, the offerer needs to suggest a new BUNDLE-tag
   [Section 8.2.2].

   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 17.4] 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 17.5] 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 data
   with the correct protocol.

   In addition, if a received data can be associated with more than one
   bundled "m=" line, there MUST exist a publicly available
   specification which describes a mechanism for associating the
   received data with the correct "m=" line.

This document describes a mechanism to identify the protocol of
received data among the STUN, DTLS and SRTP protocols (in any
combination), when UDP is used as transport-layer protocol, but does
not describe how to identify different protocols transported on DTLS.
While the mechanism is generally applicable to other protocols and
transport-layers protocols, any such use requires further
specification around how to multiplex multiple protocols on a given
transport-layer protocols, and how to associate received data with
the correct protocols.

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, Datagram Transport
Layer Security (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-
   hdrext: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 inform each other which SSRC values they
will use or RTP and RTCP by using the SDP 'ssrc' attribute [RFC5576].
To allow for proper association with this mechanism, the 'ssrc'
attribute needs to be associated with each "m=" line that shares a
payload type with any other "m=" line in the same bundle. 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 14, 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 enabled, the same address:port
combination will be used for receiving (and sending) all RTP packets
and the RTCP packets associated with the BUNDLE group. Each endpoint
will send the packets towards the BUNDLE address of the other
endpoint.

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. If the remote endpoint has associated an SDP
'rtcp' attribute with the "m=" line associated with the BUNDLE-tag,

   the attribute value will be used for sending all RTCP packets
   associated with the BUNDLE group towards that endpoint.

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' and 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 that 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. DTLS Considerations

One or more media streams within a BUNDLE group might use the
Datagram Transport Layer Security (DTLS) protocol [RFC6347] in order
to encrypt the data, or to negotiate encryption keys if another
encryption mechanism is used to encrypt media.

When DTLS is used within a BUNDLE group, the following rules apply:

o There can only be one DTLS association [RFC6347] associated with
   the BUNDLE group;

o Each usage of the DTLS association within the BUNDLE group MUST
   use the same mechanism for determining which endpoints (the
   offerer or answerer) becomes DTLS client and DTLS server; and

o If the DTLS client supports DTLS-SRTP [RFC5764] it MUST include
   the 'use_srtp' extension [RFC5764] in the DTLS ClientHello message
   [RFC5764], The client MUST include the extension even if the usage
   of DTLS-SRTP is not negotiated as part of the multimedia session
   (e.g. SIP session [RFC3261].

NOTE: The inclusion of the 'use_srtp' extension during the initial
DTLS handshake ensures that a DTLS renegotiation will not be required
in order to include the extension, in case DTLS-SRTP encrypted media
is added to the BUNDLE group later during the multimedia session.

13. Update to RFC 3264

13.1. 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).

13.2. **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.

13.3. **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.

13.4. **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.

13.5. **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."

13.6. 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.

13.7. 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.

14. RTP/RTCP extensions for identification-tag transport

14.1. 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 SDES 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. A media
recipient informs the media sender about the identification-tag
associated with an "m=" line through the use of an 'mid' attribute
[RFC5888]. The media sender then inserts the identification-tag in
RTCP and RTP packets sent to the media recipient.

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 SDES 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
SDES 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.

14.2. RTCP MID SDES Item

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |    MID=TBD   |    length   | identification-tag        ...
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

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 SDES identifier value.]

14.3. 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 SDES 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.

15. IANA Considerations

15.1. New SDES item

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

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

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

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

15.2. 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-hdrext:sdes:mid
      Description:   Media identification
      Contact:       christer.holmberg@ericsson.com
      Reference:     RFCXXXX
```

15.3. 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
```

15.4. New SDP Group Semantics

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

This document registers the following semantics with IANA in the
"Semantics for the "group" SDP Attribute" subregistry (under the
"Session Description Protocol (SDP) Parameters" registry:

```
    Semantics                                Token   Reference
    ------------------------------------     ------  ---------
    Media bundling                           BUNDLE  [RFCXXXX]
```

16. 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.

17. Examples

17.1. 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.

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 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-hdrext: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-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
```

17.2. 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-hdrext: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-hdrext: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
```

17.3. 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.

   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-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 20000 RTP/AVP 66
      b=AS:1000
      a=mid:zen
      a=rtpmap:66 H261/90000
      a=extmap 1 urn:ietf:params:rtp-hdrext: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-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 20000 RTP/AVP 66
         b=AS:1000
         a=mid:zen
         a=rtpmap:66 H261/90000
         a=extmap 1 urn:ietf:params:rtp-hdrext:sdes:mid
```

17.4. 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-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 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-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 60000 RTP/AVP 66
        b=AS:1000
        a=mid:zen
        a=rtpmap:66 H261/90000
```

17.5. 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
```

18. 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 Andreasen, Thomas
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document editing.

19. Change Log

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

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-21

o - Correct based on comment from Paul Kyzivat

o -- 'received packets' replaced with 'received data'

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-20

o - Clarification based on comment from James Guballa

o - Clarification based on comment from Flemming Andreasen

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-19

o - DTLS Considerations section added.

o - BUNDLE semantics added to the IANA Considerations

o - Changes based on WGLC comments from Adam Roach

o -- http://www.ietf.org/mail-archive/web/mmusic/current/
   msg14673.html

Changes from draft-ietf-mmusic-sdp-bundle-negotiation-18

o - Changes based on agreements at IETF#92

o -- BAS Offer removed, based on agreement at IETF#92.

o -- Procedures regarding usage of SDP "b=" line is replaced with a
   reference to to draft-ietf-mmusic-sdp-mux-attributes.

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 alligned 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.

20. References

20.1. Normative References

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[I-D.mmusic-sdp-mux-attributes]
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           (work in progress), January 2015.

20.2. Informative References

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              2010.

   [RFC5576] Lennox, J., Ott, J., and T. Schierl, "Source-Specific
              Media Attributes in the Session Description Protocol
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   [RFC6347] Rescorla, E. and N. Modadugu, "Datagram Transport Layer
              Security Version 1.2", RFC 6347, January 2012.

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              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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