MMUSIC   C. Holmberg
Internet-Draft   Ericsson
Intended status: Standards Track   R. Shpount
Expires: July 13, 2017   TurboBridge
                                                            S. Loreto
                                                         G. Camarillo
                                                             Ericsson
                                                      January 9, 2017

Session Description Protocol (SDP) Offer/Answer Procedures For Stream Control Transmission Protocol (SCTP) over Datagram Transport Layer Security (DTLS) Transport.
draft-ietf-mmusic-sctp-sdp-21

Abstract

   The Stream Control Transmission Protocol (SCTP) is a transport
   protocol used to establish associations between two endpoints.
   draft-ietf-tsvwg-sctp-dtls-encaps-09 specifies how SCTP can be used
   on top of the Datagram Transport Layer Security (DTLS) protocol,
   referred to as SCTP-over-DTLS.

   This specification defines the following new Session Description
   Protocol (SDP) protocol identifiers (proto values):'UDP/DTLS/SCTP'
   and 'TCP/DTLS/SCTP'. This specification also specifies how to use
   the new proto values with the SDP Offer/Answer mechanism for
   negotiating SCTP-over-DTLS associations.

Status of This Memo

Copyright Notice

Table of Contents

1. Introduction

   SDP (Session Description Protocol) [RFC4566] provides a general-
   purpose format for describing multimedia sessions in announcements or
   invitations. TCP-Based Media Transport in the Session Description
   Protocol (SDP) [RFC4145] specifies a general mechanism for describing
   and establishing TCP [RFC0793] streams. Connection-Oriented Media
   Transport over the Transport Layer Security (TLS) Protocol in SDP
   [RFC4572] extends RFC4145 [RFC4145] for describing TCP-based media
   streams that are protected using TLS.

   The Stream Control Transmission Protocol (SCTP) [RFC4960] is a
   transport protocol used to establish associations between two
   endpoints.

   [I-D.ietf-tsvwg-sctp-dtls-encaps] specifies how SCTP can be used on
   top of the Datagram Transport Layer Security (DTLS) protocol,
   referred to as SCTP-over-DTLS.

   This specification defines the following new Session Description
   Protocol (SDP) [RFC4566] protocol identifiers (proto
   values):'UDP/DTLS/SCTP' and 'TCP/DTLS/SCTP'. This specification also
   specifies how to use the new proto values with the SDP Offer/Answer
   mechanism [RFC3264] for negotiating SCTP-over-DTLS associations.

NOTE: Due to the characteristics of TCP, usage of 'TCP/DTLS/SCTP' will always force ordered and reliable delivery of the SCTP packets, which limits the usage of the SCTP options. Therefore, it is strongly RECOMMENDED that TCP is only used in situations where UDP traffic is blocked.

2. 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 [RFC2119].

3. SCTP Terminology

SCTP Association: A protocol relationship between SCTP endpoints, composed of the two SCTP endpoints and protocol state information including Verification Tags and the currently active set of Transmission Sequence Numbers (TSNs), etc. An association can be uniquely identified by the transport addresses used by the endpoints in the association.

SCTP Stream: A unidirectional logical channel established from one to another associated SCTP endpoint, within which all user messages are delivered in sequence except for those submitted to the unordered delivery service.

SCTP-over-DTLS: SCTP used on top of DTLS, as specified in [I-D.ietf-tsvwg-sctp-dtls-encaps].

4. SDP Media Descriptions

4.1. General

This section defines the following new SDP Media Description (m-line) protocol identifiers (proto values) for describing an SCTP association: 'UDP/DTLS/SCTP' and 'TCP/DTLS/SCTP'. The section also describes how an m- line, associated with the proto values, is created.

The following is the format for an 'm' line, as specified in RFC4566 [RFC4566]:

    m=<media> <port> <proto> <fmt> ...

The 'UDP/DTLS/SCTP' and 'TCP/DTLS/SCTP' proto values are similar to both the 'UDP' and 'TCP' proto values in that they only describe the transport-layer protocol and not the upper-layer protocol.

   NOTE: When the 'UDP/DTLS/SCTP' and 'TCP/DTLS/SCTP' proto values are
   used, the underlying transport protocol is respectively UDP and TCP;
   SCTP is carried on top of DTLS which is on top of those transport-
   layer protocols.

   The m- line fmt value, identifying the application-layer protocol,
   MUST be registered by IANA.

4.2. Protocol Identifiers

   The new proto values are defined as below:

   o The 'UDP/DTLS/SCTP' proto value describes an SCTP association on
      top of a DTLS association on top of UDP, as defined in Section 7.

   o The 'TCP/DTLS/SCTP' proto value describes an SCTP association on
      top of a DTLS association on top of TCP, as defined in Section 8.

4.3. Media Format Management

   [RFC4566] defines that specifications defining new proto values must
   define the rules by which their media format (fmt) namespace is
   managed.

   An m- line with a proto value of 'UDP/DTLS/SCTP' or 'TCP/DTLS/SCTP'
   always describes a single SCTP association.

   In addition, such m- line MUST further indicate the application-layer
   protocol using an 'fmt' identifier. There MUST be exactly one 'fmt'
   value per m- line associated with the proto values defined in this
   specification. The "fmt" namespace associated with those proto
   values describes the generic application usage of the entire SCTP
   association, including the associated SCTP streams.

   Section 15.3 defines the IANA registry for the media format
   namespace.

   NOTE: A mechanism on how to describe, and manage, individual SCTP
   streams within an SCTP association, is outside the scope of this
   specification. [I-D.ietf-mmusic-data-channel-sdpneg] defines a
   mechanism for negotiating individual SCTP streams used to realize
   WebRTC data channels [I-D.ietf-rtcweb-data-channel].

4.4. Syntax

4.4.1. **General**

   This section defines the values that can be used within an SDP media
   description ("m=" line) associated with an SCTP-over-DTLS
   association.

   This specification creates an IANA registry for 'association-usage'
   values.

4.4.2. **SDP Media Description values**

```
   m= line parameter       parameter value(s)
   ----------------------------------------------------------------
   <media>:                "application"
   <proto>:                "UDP/DTLS/SCTP" or "TCP/DTLS/SCTP"
   <port>:                 UDP port number (for "UDP/DTLS/SCTP")
                           TCP port number (for ""UDP/DTLS/SCTP")
   <fmt>:                  a string denoting the association-usage,
                           limited to the syntax of a 'token' as
                           defined in RFC4566.
```

4.5. **Example**

```
 m=application 12345 UDP/DTLS/SCTP webrtc-datachannel
 a=max-message-size:100000
```

   NOTE: 'webrtc-datachannel' indicates the WebRTC Data Channel
   Establishment Protocol defined in [I-D.ietf-rtcweb-data-protocol].

5. **SDP 'sctp-port' Attribute**

5.1. **General**

   This section defines a new SDP media-level attribute, 'sctp-port'.
   The attribute can be associated with an SDP media description (m-
   line) with a 'UDP/DTLS/SCTP' or a 'TCP/DTLS/SCTP' proto value. In
   that case the m- line port value indicates the port of the underlying
   transport layer protocol (UDP or TCP), and the 'sctp-port' value
   indicates the SCTP port.

   No default value is defined for the SDP sctp-port attribute.
   Therefore, if the attribute is not present, the associated m- line
   MUST be considered invalid.

NOTE: This specification only defines the usage of the SDP 'sctp-port' attribute when associated with an m- line containing one of the following proto values: 'UDP/DTLS/SCTP' or 'TCP/DTLS/SCTP'. Usage of the attribute with other proto values needs to be defined in a separate specification.

5.2. Syntax

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

The definition of the SDP 'sctp-port' attribute is:


```
   Attribute name:      sctp-port
   Type of attribute:   media
   Mux category:        SPECIAL
   Subject to charset:  No
   Purpose:             Indicate the SCTP port value associated with
                        the SDP Media Description.
   Appropriate values:  Integer
   Contact name:        Christer Holmberg
   Contact e-mail:      christer.holmberg@ericsson.com
   Reference:           RFCXXXX
```

Syntax:

        sctp-port-value = 1*5<DIGIT defined in RFC4566>

The SCTP port range is between 0 and 65535 (both included). Leading zeroes MUST NOT be used.

Example:

        a=sctp-port:5000

5.3. Mux Category

The mux category [I-D.ietf-mmusic-sdp-mux-attributes] for the SDP 'sctp-port' attribute is SPECIAL.

As the usage of multiple SCTP associations on top of a single DTLS association is outside the scope of this specification, no mux rules are specified for the 'UDP/DTLS/SCTP' and 'TCP/DTLS/SCTP' proto values. Future extensions, that define how to negotiate multiplexing of multiple SCTP associations of top of a single DTLS association, need to also define the mux rules for the attribute.

[6](#). **SDP 'max-message-size' Attribute**

[6.1](#). **General**

   This section defines a new SDP media-level attribute, 'max-message-
   size'. The attribute can be associated with an m- line to indicate
   the maximum SCTP user message size (indicated in bytes) that an SCTP
   endpoint is willing to receive on the SCTP association associated
   with the m- line. Different attribute values can be used in each
   direction.

   An SCTP endpoint MUST assume that larger SCTP user message sizes will
   be rejected by the peer SCTP endpoint. SCTP endpoints need to decide
   on appropriate behavior in case a message needs to be sent in which
   the SCTP user message size exceeds thevmaximum SCTP user message
   size.

   If the SDP 'max-message-size' attribute contains a maximum message
   size value of zero, it indicates the SCTP endpoint will handle
   messages of any size, subject to memory capacity etc.

   If the SDP 'max-message-size' attribute is not present, the default
   value is 64K.

   NOTE: This specification only defines the usage of the SDP 'max-
   message-size' attribute when associated with an m- line containing
   one of the following proto values: 'UDP/DTLS/SCTP' or 'TCP/DTLS/
   SCTP'. Usage of the attribute with other proto values needs to be
   defined in a separate specification.

[6.2](#). **Syntax**

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

   The definition of the SDP 'max-message-size' attribute is:

```
            Attribute name:     max-message-size
                Type of attribute:  media
                Mux category:       SPECIAL
                Subject to charset: No
            Purpose:            Indicate the maximum message size that
                                an SCTP endpoint is willing to receive
                                on the SCTP association associated
                                with the SDP Media Description.
                Appropriate values: Integer
                Contact name:       Christer Holmberg
                Contact e-mail:     christer.holmberg@ericsson.com
                Reference:          RFCXXXX
```

   Syntax:

   max-message-size-value = 1*<DIGIT defined in [RFC4566]>

   Leading zeroes MUST NOT be used.

   Example:

   a=max-message-size:100000

6.3. Mux Category

   The mux category for the SDP 'max-message-size' attribute is SPECIAL.

   As the usage of multiple SCTP associations on top of a single DTLS
   association is outside the scope of this specification, no mux rules
   are specified for the 'UDP/DTLS/SCTP' and 'TCP/DTLS/SCTP' proto
   values.

7. UDP/DTLS/SCTP Transport Realization

   The UDP/DTLS/SCTP transport is realized as described below:

   o SCTP on top of DTLS is realized according to the procedures
      defined in [I-D.ietf-tsvwg-sctp-dtls-encaps]; and

   o DTLS on top of UDP is realized according to the procedures in
      defined in [RFC6347].

   NOTE: While [I-D.ietf-tsvwg-sctp-dtls-encaps] allows multiple SCTP
   associations on top of a single DTLS association, the procedures in
   this specification only support the negotiation of a single SCTP
   association on top of any given DTLS association.

8. **TCP/DTLS/SCTP Transport Realization**

   The TCP/DTLS/SCTP transport is realized as described below:

   o SCTP on top of DTLS is realized according to the procedures
      defined in [I-D.ietf-tsvwg-sctp-dtls-encaps]; and

   o DTLS on top of TCP is realized using the framing method defined in
      [RFC4571], with DTLS packets being sent instead of RTP/RTCP
      packets, and SDP signaling according to the procedures defined in
      this specification.

   NOTE: DTLS on top of TCP, without using the framing method defined in
   [RFC4571] is outside the scope of this specification. A separate
   proto value would need to be registered for such transport
   realization.

9. **Association And Connection Management**

9.1. **General**

   This section describes how to mange an SCTP association, DTLS
   association and TCP connection using SDP attributes.

   The SCTP association, the DTLS association and the TCP connection are
   managed independently from each other. Each can be established and
   closed without impacting others.

   The detailed SDP Offer/Answer [RFC3264] procedures for the SDP
   attributes are described in Section 10.

9.2. **SDP sendrecv/sendonly/recvonly/inactive Attribute**

   This specification does not define semantics for the SDP direction
   attributes [RFC4566]. Unless semantics of these attributes for an
   SCTP association usage have been defined, SDP direction attributes
   MUST be ignored if present.

9.3. **SCTP Association**

   When an SCTP association is established, both SCTP endpoints MUST
   initiate the SCTP association (i.e. both SCTP endpoints take the
   'active' role), and MUST use the same SCTP port as client port and
   server port (in order to prevent two separate SCTP associations from
   being established).

   As both SCTP endpoints take the 'active' role, the SDP 'setup'
   attribute [RFC4145] does not apply to SCTP association establishment.

However the 'setup' attribute does apply to establishment of the
underlying DTLS association and TCP connection.

NOTE: The procedure above is different from TCP, where one endpoint
takes the 'active' role, the other endpoint takes the 'passive' role,
and only the 'active' endpoint initiates the TCP connection
[RFC4145].

NOTE: When the SCTP association is established it is assumed that any
NAT traversal procedures for the underlying transport protocol (UDP
or TCP) have successfully been performed.

The SDP 'connection' attribute [RFC4145] does not apply to the SCTP
association. In order to trigger the closure of an existing SCTP
association, and establishment of a new SCTP association, the SDP
'sctp-port' attribute [Section 5] is used to indicate a new
(different than the ones currently used) SCTP port. The existing
SCTP association is closed, and the new SCTP association is
established, if one or both endpoints signal a new SCTP port. The
'connection' attribute does apply to establishment of underlying TCP
connections.

Alternatively, an SCTP association can be closed using the SDP 'sctp-
port' attribute with a zero attribute value. Later, a new SCTP
association can be established using the procedures in this section
for establishing an SCTP association.

SCTP associations might be closed without SDP signalling, e.g, in
case of a failure. The procedures in this section MUST be followed
to establish a new SCTP association. This requires a new SDP Offer/
Answer exchange. New (different than the ones currently used) SCTP
ports MUST be used by both endpoints.

NOTE: Closing and establishing a new SCTP association using the SDP
'sctp-port' attribute will not impact the underlying DTLS
association.

9.4. DTLS Association (UDP/DTLS/SCTP And TCP/DTLS/SCTP)

A DTLS association is managed according to the procedures in
[I-D.ietf-mmusic-dtls-sdp]. Hence, the SDP 'setup' attribute is used
to negotiate the (D)TLS roles ('client' and 'server') [RFC4572].

NOTE: The SDP 'setup' attribute is used to negotiate both the DTLS
roles and the TCP roles (Section 9.5).

NOTE: As described in [RFC5245], if the Interactive Connectivity
Establishment (ICE) mechanism [RFC5245] is used, all ICE candidates

associated with a DTLS association are considered part of the same
DTLS association. Thus, a switch from one candidate pair to another
candidate pair will not trigger the establishment of a new DTLS
association.

9.5. TCP Connection (TCP/DTLS/SCTP)

The TCP connection is managed according to the procedures in
[RFC4145]. Hence, the SDP 'setup' attribute is used to negotiate the
TCP roles ('active' and 'passive'), and the SDP 'connection'
attribute is used to indicate whether to use an existing TCP
connection, or create a new one. The SDP 'setup' attribute
'holdconn' value MUST NOT be used.

NOTE: A change of the TCP roles will also trigger a closure of the
DTLS association, and establishment of a new DTLS association,
according to the procedures in [I-D.ietf-mmusic-dtls-sdp].

NOTE: As specified in [I-D.ietf-mmusic-dtls-sdp], usage of the SDP
'setup' attribute 'holdconn' value is not allowed. Therefore this
specification also forbids usage of the attribute value for TCP, as
DTLS is transported on top of TCP.

10. SDP Offer/Answer Procedures

10.1. General

This section defines the SDP Offer/Answer [RFC3264] procedures for
negotiating and establishing an SCTP-over-DTLS association. Unless
explicitly stated, the procedures apply to both the 'UDP/DTLS/SCTP'
and 'TCP/DTLS/SCTP' m- line proto values.

Each endpoint MUST associate one or more certificate fingerprints,
using the SDP 'fingerprint' attribute with the m- line, following the
procedures in [I-D.ietf-mmusic-4572-update].

The authentication certificates are interpreted and validated as
defined in [I-D.ietf-mmusic-4572-update]. Self-signed certificates
can be used securely, provided that the integrity of the SDP
description is assured as defined in [I-D.ietf-mmusic-4572-update].

Each endpoint MUST associate an SDP 'dtls-id' attribute with the m-
line, following the procedures in [I-D.ietf-mmusic-dtls-sdp].

10.2. Generating the Initial SDP Offer

   When the offerer creates an initial offer, the offerer:

   o MUST associate an SDP setup attribute with the m- line;

   o MUST associate an SDP 'sctp-port' attribute with the m- line;

   o MUST, in the case of TCP/DTLS/SCTP, associate an SDP 'connection'
      attribute, with a 'new' attribute value, with the m- line; and

   o MAY associate an SDP 'max-message-size' attribute [Section 6] with
      the m- line.

10.3. Generating the SDP Answer

   When the answerer receives an offer, which contains an m- line
   describing an SCTP-over-DTLS association, if the answerer accepts the
   association, the answerer:

   o MUST insert a corresponding m- line in the answer, with an
      identical m- line proto value [RFC3264];

   o MUST associate an SDP 'setup' attribute with the m- line;

   o MUST associate an SDP 'sctp-port' attribute with the m- line. If
      the offer contained a new (different than the one currently used)
      SCTP port value the answerer MUST also associate a new SCTP port
      value. If the offer contained a zero SCTP port value, or if the
      answerer does not accept the SCTP association, the answerer MUST
      also associate a zero SCTP port value; and

   o MAY associate an SDP 'max-message-size' attribute [Section 6] with
      the m- line. The attribute value in the answer is independent
      from the value (if present) in the corresponding m- line of the
      offer.

   Once the answerer has sent the answer the answerer:

   o MUST, in the case of TCP/DTLS/SCTP, if a TCP connection has not
      yet been established, or if an existing TCP connection is to be
      closed and replaced by a new TCP connection, follow the procedures
      in [RFC4145] for closing and establishing a TCP connection;

   o MUST, if a DTLS association has not yet been established, or if an
      existing DTLS association is to be closed and replaced by a new
      DTLS association, follow the procedures in

[I-D.ietf-mmusic-dtls-sdp] for closing establishing a DTLS
association; and

o MUST, if an SCTP association has not yet been established, or if
   an existing SCTP association is to be closed and replaced by a new
   SCTP association, initiate the closing of the existing SCTP
   association (if applicable) and establishment of the SCTP
   association.

If the SDP 'sctp-port' attribute in the answer contains a zero
attribute value, the answerer MUST NOT establish an SCTP association.
If an SCTP association exists, the offerer MUST close it.

If the answerer does not accept the m- line in the offer, it MUST
assign a zero port value to the corresponding m- line in the answer,
following the procedures in [RFC3264]. In addition, the answerer
MUST NOT initiate the establishment of a TCP connection, a DTLS
association or a DTLS association associated with the m- line.

10.4. Offerer Processing of the SDP Answer

Once the offerer has received the answer the offerer:

o MUST, in the case of TCP/DTLS/SCTP, if a TCP connection has not
   yet been established, or if an existing TCP connection is to be
   closed and replaced by a new TCP connection, follow the procedures
   in [RFC4145] for closing and establishing a TCP connection;

o MUST, if a DTLS association has not yet been established, or if an
   existing DTLS association is to be closed and replaced by a new
   DTLS association, follow the procedures in
   [I-D.ietf-mmusic-dtls-sdp] for closing and establishing a DTLS
   association; and

o MUST, if an SCTP association has not yet been established, or if
   an existing SCTP association is to be closed and replaced by a new
   SCTP association, initiate the closing of the existing SCTP
   association (if applicable) and establishment of the SCTP
   association.

If the SDP 'sctp-port' attribute in the answer contains a zero
attribute value, the offerer MUST NOT establish an SCTP association.
If an SCTP association exists in that case, the offerer MUST close
it.

If the m- line in the answer contains a zero port value, the offerer
MUST NOT initiate the establishment a TCP connection, a DTLS
association or an SCTP association associated with the m- line. If a

TCP connection, or a DTLS association or an SCTP association exists in that case, the offerer MUST close it.

10.5. Modifying the Session

When an offerer sends an updated offer, in order to modify a previously established SCTP association, it follows the procedures in Section 10.2, with the following exceptions:

o If the offerer wants to close an SCTP association, and immediately establish a new SCTP association, the offerer MUST associate an SDP 'sctp-port' attribute with a new (different than the one currently used) attribute value. This will not impact the underlying DTLS association (and TCP connection in case of TCP/DTLS/SCTP).

o If the offerer wants to close an SCTP association, without immediately establishing a new SCTP association, the offerer MUST associate an SDP 'sctp-port' attribute with a zero attribute value. This will not impact the underlying DTLS association (and TCP connection in case of TCP/DTLS/SCTP).

o If the offerer wants to establish an SCTP association, and another SCTP association was previously closed, the offerer MUST associate an SDP 'sctp-port' attribute with a new attribute value (different than the value associated with the previous SCTP association). If the previous SCTP association was closed successfully following use of an SDP 'sctp-port' attribute with a zero attribute value, the offerer MAY use the same attribute value for the new SCTP association that was used with the previous SCTP association before it was closed. This will not impact the underlying DTLS association (and TCP connection in case of TCP/DTLS/SCTP).

o If the offerer wants to close an existing SCTP association, and the underlying DTLS association (and the underlying TCP connection in case of TCP/DTLS/SCTP) it MUST assign a zero port value to the m- line associated with the SCTP and DTLS associations (and TCP connection in case of TCP/DTLS/SCTP), following the procedures in [RFC3264].

o NOTE: This specification does not define a mechanism for explicitly closing a DTLS association while maintaining the overlying SCTP association. However, if a DTLS association is closed and replaced with a new DTLS association, as a result of some other action [I-D.ietf-mmusic-dtls-sdp], the SCTP association is not affected.

The offer follows the procedures in [I-D.ietf-mmusic-dtls-sdp]
regarding the DTLS association impacts when modifying a session.

In the case of TCP/DTLS/SCTP, the offerer follows the procedures in
[RFC4145] regarding the TCP connection impacts when modifying a
session.

11. Multihoming Considerations

Multihoming is not supported when sending SCTP on top of DTLS, as
DTLS does not expose address management of the underlying transport
protocols (UDP or TCP) to its upper layer.

12. NAT Considerations

12.1. General

When SCTP-over-DTLS is used in NAT environment, it relies on the NAT
traversal procedures for the underlying transport protocol (UDP or
TCP).

12.2. ICE Considerations

When SCTP-over-DTLS is used with UDP based ICE candidates [RFC5245]
then the procedures for UDP/DTLS/SCTP [Section 7] are used.

When SCTP-over-DTLS is used with TCP based ICE candidates [RFC6544]
then the procedures for TCP/DTLS/SCTP [Section 8] are used.

Implementations MUST treat all ICE candidate pairs associated with an
SCTP association on top of a DTLS association as part of the same
DTLS association. Thus, there will only be one SCTP handshake and
one DTLS handshake even if there are multiple valid candidate pairs,
and shifting from one candidate pair to another will not impact the
SCTP or DTLS associations. If new candidates are added, they will
also be part of the same SCTP and DTLS associations. When
transitioning between candidate pairs, different candidate pairs can
be currently active in different directions and implementations MUST
be ready to receive data on any of the candidates, even if this means
sending and receiving data using UDP/DTLS/SCTP and TCP/DTLS/SCTP at
the same time in different directions.

When an SDP offer or answer is sent, the proto value MUST match the
transport protocol associated with the default candidate. Hence, if
UDP transport is used for the default candidate the 'UDP/DTLS/SCTP'
proto value MUST be used. If TCP transport is used for the default
candidate the 'TCP/DTLS/SCTP' proto value MUST be used. However, if
an endpoint switches between TCP-based and UDP-based candidates

during a session the endpoint is not required to send an SDP offer in
order to modify that proto value of the associated m- line.

NOTE: The text in the paragraph above only applies when the usage of
ICE has been negotiated. If ICE is not used, the proto value MUST
always reflect the transport protocol used at any given time.

13. Examples

13.1. Establishment of UDP/DTLS/SCTP association

 SDP Offer:

```
m=application 54111 UDP/DTLS/SCTP webrtc-datachannel
c=IN IP4 192.0.2.1
a=dtls-id:abc3dl
a=setup:actpass
a=sctp-port:5000
a=max-message-size:100000
```

    - The offerer indicates that the usage of the
      UDP/DTLS/SCTP association will be as defined
      for the 'webrtc-datachannel' format value.
    - The offerer UDP port value is 54111.
    - The offerer SCTP port value is 5000.
    - The offerer indicates that it can take either the
      client or the server DTLS role.

 SDP Answer:

```
m=application 64300 UDP/DTLS/SCTP webrtc-datachannel
c=IN IP4 192.0.2.2
a=dtls-id:ggr4rd
a=setup:passive
a=sctp-port:6000
a=max-message-size:100000
```

    - The answerer UDP port value is 64300.
    - The answerer SCTP port value is 6000.
    - The answerer takes the server DTLS role.

14. Security Considerations

[RFC4566] defines general SDP security considerations, while
[RFC3264], [RFC4145] and [RFC4572] define security considerations
when using the SDP offer/answer mechanism to negotiate media
streams.

[RFC4960] defines general SCTP security considerations and
[I-D.ietf-tsvwg-sctp-dtls-encaps] defines security considerations
when using SCTP on top of DTLS.

This specification does not introduce new security considerations in
addition to those defined in the specifications listed above.

15. IANA Considerations

15.1. New SDP proto values

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

This document updates the "Session Description Protocol (SDP)
Parameters" registry, following the procedures in [RFC4566], by
adding the following values to the table in the SDP "proto" field
registry:

```
            +-------+---------------+-----------+
            | Type  |   SDP Name    | Reference |
            +-------+---------------+-----------+
            | proto | UDP/DTLS/SCTP | [RFCXXXX] |
            | proto | TCP/DTLS/SCTP | [RFCXXXX] |
            +-------+---------------+-----------+
```

Table 1: SDP "proto" field values

15.2. New SDP Attributes

15.2.1. sctp-port

This document defines a new SDP media-level attribute,'sctp-port'.
The details of the attribute are defined in Section 5.2.

15.2.2. max-message-size

This document defines a new SDP media-level attribute,'max-message-
size'. The details of the attribute are defined in Section 6.2.

15.3. association-usage Name Registry

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

This specification creates a new IANA registry, following the procedures in [RFC5226], for the "fmt" namespace associated with the 'UDP/DTLS/SCTP' and 'TCP/DTLS/SCTP' protocol identifiers. Each "fmt" value describes the usage of an entire SCTP association, including all SCTP streams associated with the SCTP association.

NOTE: Usage indication of individual SCTP streams is outside the scope of this specification.

The "fmt" value, "association-usage", used with these "proto" values is required. It is defined in Section 4.

As part of this registry, IANA maintains the following information:

association-usage name: The identifier of the subprotocol, as will be used as the "fmt" value.

association-usage reference: A reference to the document in which the association-usage is defined.

association-usage names are to be subject to the "First Come First Served" IANA registration policy [RFC5226].

IANA is asked to add initial values to the registry.

```
|---------------------------------------------------------------|
|         name          |              Reference                |
|---------------------------------------------------------------|
| webrtc-datachannel    | draft-ietf-rtcweb-data-protocol-xx,   |
|                       | RFCXXX                                |
|---------------------------------------------------------------|
```

[RFC EDITOR NOTE: Please hold the publication of this draft until draft-ietf-rtcweb-data-protocol has been published as an RFC. Then, replace the reference to draft-ietf-rtcweb-data-protocol with the RFC number.]

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

Figure 1

16. Acknowledgments

The authors wish to thank Harald Alvestrand, Randell Jesup, Paul
Kyzivat, Michael Tuexen, Juergen Stoetzer-Bradler, Flemming Andreasen
and Ari Keranen for their comments and useful feedback.

17.

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

Changes from draft-ietf-mmusic-sctp-sdp-20

o Informative reference to draft-ietf-rtcweb-data-protocol added.

Changes from draft-ietf-mmusic-sctp-sdp-19

o Changes based on WG chair comments from Flemming Andreasen.

Changes from draft-ietf-mmusic-sctp-sdp-18

o Changes based on WGLC comments from Paul Kyzivat.

Changes from draft-ietf-mmusic-sctp-sdp-17

o Removal of 'SCTP'.

o Document title changed.

o Disallow usage of SDP 'setup' attribute 'holdconn' value.

o Roman Shpount added as co-editor.

Changes from draft-ietf-mmusic-sctp-sdp-15

o Chapter about SCTP, DTLS and TCP association/connection management
   modified.

o Removal of SCTP/DTLS.

Changes from draft-ietf-mmusic-sctp-sdp-14

o Changes based on WGLC comments from Magnus Westerlund.

o - ABNF clarification that token and port are defined in RFC4566.

o - Specify 40 as maximum digit character length for the SDP max-
   message-size value.

o - Editorial clarification.

o Changes based on discussions at IETF#92.

o - Specify that all ICE candidate pairs belong to the same DTLS
   association.

Changes from draft-ietf-mmusic-sctp-sdp-13

o Changes based on comments from Paul Kyzivat.

o - Text preventing usage of well-known ports removed.

o - Editorial clarification.

Changes from draft-ietf-mmusic-sctp-sdp-12

o Mux category rules added for new SDP attributes.

o Reference to draft-ietf-mmusic-sdp-mux-attributes added.

o Changes based on comments from Roman Shpount:

o - Specify that fingerprint or setup roles must not be modified,
   unless underlying transport protocol is also modified.

o Changes based on comments from Ari Keranen:

o - Editorial corrections.

o Changes based on comments from Flemming Andreasen:

o - Clarify that, if UDP/DTLS/SCTP or TCP/DTLS/SCTP is used, the
   DTLS association is established before the SCTP association.

o - Clarify that max-message-size value is given in bytes, and that
   different values can be used per direction.

o - Section on fmtp attribute removed.

o - Editorial corrections.

Changes from draft-ietf-mmusic-sctp-sdp-11

o Example added.

Changes from draft-ietf-mmusic-sctp-sdp-10

o SDP max-message-size attribute added to IANA considerations.

o Changes based on comments from Paul Kyzivat:

o - Text about max message size removed from fmtp attribute section.

Changes from draft-ietf-mmusic-sctp-sdp-09

o 'DTLS/SCTP' split into 'UDP/DTLS/SCTP' and 'TCP/DTLS/SCTP'

o Procedures for realizing UDP/DTLS/SCTP- and TCP/DTLS/SCTP
   transports added.

Changes from draft-ietf-mmusic-sctp-sdp-08

o Default SCTP port removed:

o - Usage of SDP sctp-port attribute mandatory.

o SDP max-message-size attribute defined:

o - Attribute definition.

o - SDP Offer/Answer procedures.

o Text about SDP direction attributes added.

o Text about TLS role determination added.

18. References

18.1. Normative References

   [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
              Requirement Levels", BCP 14, RFC 2119,
              DOI 10.17487/RFC2119, March 1997,
              <http://www.rfc-editor.org/info/rfc2119>.

   [RFC3264] Rosenberg, J. and H. Schulzrinne, "An Offer/Answer Model
              with Session Description Protocol (SDP)", RFC 3264,
              DOI 10.17487/RFC3264, June 2002,
              <http://www.rfc-editor.org/info/rfc3264>.

   [RFC4145] Yon, D. and G. Camarillo, "TCP-Based Media Transport in
              the Session Description Protocol (SDP)", RFC 4145,
              DOI 10.17487/RFC4145, September 2005,
              <http://www.rfc-editor.org/info/rfc4145>.

   [RFC4566] Handley, M., Jacobson, V., and C. Perkins, "SDP: Session
              Description Protocol", RFC 4566, DOI 10.17487/RFC4566,
              July 2006, <http://www.rfc-editor.org/info/rfc4566>.

   [RFC4571] Lazzaro, J., "Framing Real-time Transport Protocol (RTP)
              and RTP Control Protocol (RTCP) Packets over Connection-
              Oriented Transport", RFC 4571, DOI 10.17487/RFC4571, July
              2006, <http://www.rfc-editor.org/info/rfc4571>.

   [RFC4572] Lennox, J., "Connection-Oriented Media Transport over the
              Transport Layer Security (TLS) Protocol in the Session
              Description Protocol (SDP)", RFC 4572,
              DOI 10.17487/RFC4572, July 2006,
              <http://www.rfc-editor.org/info/rfc4572>.

   [RFC4960] Stewart, R., Ed., "Stream Control Transmission Protocol",
              RFC 4960, DOI 10.17487/RFC4960, September 2007,
              <http://www.rfc-editor.org/info/rfc4960>.

   [RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an
              IANA Considerations Section in RFCs", BCP 26, RFC 5226,
              DOI 10.17487/RFC5226, May 2008,
              <http://www.rfc-editor.org/info/rfc5226>.

   [RFC6347] Rescorla, E. and N. Modadugu, "Datagram Transport Layer
              Security Version 1.2", RFC 6347, DOI 10.17487/RFC6347,
              January 2012, <http://www.rfc-editor.org/info/rfc6347>.

   [I-D.ietf-mmusic-4572-update]
              Lennox, J. and C. Holmberg, "Connection-Oriented Media
              Transport over TLS in SDP", draft-ietf-mmusic-
              4572-update-10 (work in progress), January 2017.

   [I-D.ietf-mmusic-dtls-sdp]
              Holmberg, C. and R. Shpount, "Using the SDP Offer/Answer
              Mechanism for DTLS", draft-ietf-mmusic-dtls-sdp-15 (work
              in progress), October 2016.

   [I-D.ietf-tsvwg-sctp-dtls-encaps]
              Tuexen, M., Stewart, R., Jesup, R., and S. Loreto, "DTLS
              Encapsulation of SCTP Packets", draft-ietf-tsvwg-sctp-
              dtls-encaps-09 (work in progress), January 2015.

   [I-D.ietf-mmusic-sdp-mux-attributes]
              Nandakumar, S., "A Framework for SDP Attributes when
              Multiplexing", draft-ietf-mmusic-sdp-mux-attributes-16
              (work in progress), December 2016.

18.2. Informative References

[RFC0793]   Postel, J., "Transmission Control Protocol", STD 7,
            RFC 793, DOI 10.17487/RFC0793, September 1981,
            <http://www.rfc-editor.org/info/rfc793>.

[RFC5245]   Rosenberg, J., "Interactive Connectivity Establishment
            (ICE): A Protocol for Network Address Translator (NAT)
            Traversal for Offer/Answer Protocols", RFC 5245,
            DOI 10.17487/RFC5245, April 2010,
            <http://www.rfc-editor.org/info/rfc5245>.

[RFC6544]   Rosenberg, J., Keranen, A., Lowekamp, B., and A. Roach,
            "TCP Candidates with Interactive Connectivity
            Establishment (ICE)", RFC 6544, DOI 10.17487/RFC6544,
            March 2012, <http://www.rfc-editor.org/info/rfc6544>.

[I-D.ietf-rtcweb-data-channel]
            Jesup, R., Loreto, S., and M. Tuexen, "WebRTC Data
            Channels", draft-ietf-rtcweb-data-channel-13 (work in
            progress), January 2015.

[I-D.ietf-mmusic-data-channel-sdpneg]
            Drage, K., Makaraju, M., Stoetzer-Bradler, J., Ejzak, R.,
            and (. (Unknown), "SDP-based Data Channel Negotiation",
            draft-ietf-mmusic-data-channel-sdpneg-10 (work in
            progress), September 2016.

[I-D.ietf-rtcweb-data-protocol]
            Jesup, R., Loreto, S., and M. Tuexen, "WebRTC Data Channel
            Establishment Protocol", draft-ietf-rtcweb-data-
            protocol-09 (work in progress), January 2015.

Authors' Addresses

Christer Holmberg
Ericsson
Hirsalantie 11
Jorvas 02420
Finland

Email: christer.holmberg@ericsson.com

Roman Shpount
TurboBridge
4905 Del Ray Avenue, Suite 300
Bethesda, MD 20814
USA

Phone: +1 (240) 292-6632
Email: rshpount@turbobridge.com

Salvatore Loreto
Ericsson
Hirsalantie 11
Jorvas 02420
Finland

Email: Salvatore.Loreto@ericsson.com

Gonzalo Camarillo
Ericsson
Hirsalantie 11
Jorvas 02420
Finland

Email: Gonzalo.Camarillo@ericsson.com