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Stream Control Transmission Protocol (SCTP)-Based Media Transport in the Session Description Protocol (SDP)

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Abstract

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

This specification describes how to describe SCTP associations using the Session Description Protocol (SDP), and defines the following new SDP Media Description protocol identifiers (proto values):'SCTP', 'SCTP/DTLS' and 'DTLS/SCTP'.

The specification also describes how to use the new proto values together with the SDP Offer/Answer mechanism in order to negotiate and establish SCTP associations, and how to indicate the SCTP application usage.

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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 (Transmission Control Protocol) [RFC5246] streams. Connection-Oriented Media Transport over the Transport Layer Security (TLS) Protocol in the Session Description Protocol (SDP) [RFC4572] extends RFC4145 [RFC4145] for describing TCP-based media streams that are protected using TLS.

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

This specification describes how to describe SCTP associations using the Session Description Protocol (SDP) [RFC4566], and defines the following new SDP Media Description [RFC4566] protocol identifiers (proto values):'SCTP', 'SCTP/DTLS' and 'DTLS/SCTP'.

The specification also describes how to use the new proto values together with the SDP Offer/Answer mechanism [RFC3264] in order to negotiate and establish SCTP associations, and how to indicate the SCTP application usage.

NOTE: TLS is designed to run on top of a byte-stream oriented transport protocol providing a reliable, in-sequence delivery like TCP. [RFC6083] presents serious limitations with transporting SCTP on top of TLS. Therefore, defining a mechanism to negotiate media streams transported using SCTP on top of TLS is outside the scope of this specification.

2. Terminology

In this document, the key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" are to be interpreted as described in BCP 14, RFC 2119 [RFC2119] and indicate requirement levels for compliant implementations.

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. Two SCTP endpoints MUST NOT have more than one SCTP association between them at any given time.

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 Transport address: A transport address is traditionally defined by a network-layer address, a transport-layer protocol, and a transport-layer port number. In the case of SCTP running over IP, a transport address is defined by the combination of an IP address and an SCTP port number (where SCTP is the transport protocol).

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

NOTE: When the 'DTLS/SCTP' proto value is used, the underlying transport protocol is either UDP or TCP.

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:

- The 'SCTP' proto value describes an SCTP association, as defined in [RFC4960].

- The 'SCTP/DTLS' proto value describes a Datagram Transport Layer Security (DTLS) [RFC6347] connection on top of an SCTP association, as defined in [RFC6083].

- The 'DTLS/SCTP' proto value describes an SCTP association on top of a DTLS connection, as defined in [I-D.ietf-tsvwg-sctp-dtls-encaps].

NOTE: In the case of 'DTLS/SCTP', the actual transport protocol below DTLS is either UDP or TCP.

OPEN ISSUE #1: It is FFS whether separate proto values will be used, depending on whether the underlying transport protocol is UDP (e.g. 'UDP/DTLS/SCTP') or TCP (e.g. 'TCP/DTLS/SCTP').

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. Use of an existing MIME subtype for the format is encouraged. If no MIME subtype exists, it is recommended that a suitable one is registered through the IETF process [RFC6838] [RFC4289] by production of, or reference to, a standards-track RFC that defines the transport protocol for the format.

An m- line with a proto value of 'SCTP', 'SCTP/DTLS' or 'DTLS/SCTP' always describe 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.

NOTE: A mechanism on how to describe, and manage, individual SCTP streams within an SCTP association, is outside the scope of this specification.

4.4. Syntax

```
sctp-m-line = %x6d "="
 ("application" SP sctp-port SP "SCTP"  SP sctp-fmt CRLF) /
 ("application" SP sctp-port SP "SCTP/DTLS" SP sctp-fmt CRLF) /
 ("application" SP udp-port  SP "DTLS/SCTP" SP sctp-fmt CRLF)

sctp-port = port

udp-port = port

sctp-fmt = association-usage

association-usage = token
```

4.5. Example

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

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 descriptor (m-line) with a 'DTLS/SCTP' proto value, in which case the m- line port value indicates the port of the underlying transport protocol (UDP or TCP).

If the SDP sctp-port attribute is not present, the default value is 5000.

Usage of the SDP sctp-port attribute with other proto values is not specified, and MUST be discarded if received.

5.2. Syntax

```
sctp-port-attr  =  "a=sctp-port:" portnumber
port-number     =  port
port            =  1*DIGIT
```

6. SDP 'fmtp' Attribute

6.1. General

The SDP 'fmtp' attribute can be used with an m- line, associated with an SCTP association, to indicate the maximum message size that an SCTP endpoint is willing to receive, for a particular SCTP association usage, on that SCTP association.

The remote peer MUST assume that larger messages will be rejected by the SCTP endpoint. SCTP endpoints need to decide on appropriate behaviour in case a message that exceeds the maximum size needs to be sent.

If the SDP 'fmtp' 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 'fmtp' attribute is not present, the default value is 64K.

6.2. Syntax

```
sctpmap-attr      =  "a=fmtp:" association-usage [max-message-size]
max-message-size  =  "max-message-size" EQUALS 1*DIGIT
```

7. SCTP Association Management

7.1. General

The management of an SCTP association is identical to the management of a TCP connection. An SCTP endpoints MUST follow the rules in Section 6 of [RFC4145] to manage SCTP associations. Whether to use the SCTP ordered or unordered delivery service is up to the applications using the SCTP association, and this specification does not define a mechanism to indicate the type of delivery service using SDP.

7.2. SDP setup Attribute

If the m- line proto field value is 'SCTP/DTLS' or 'DTLS/SCTP', the SDP setup attribute [RFC4145] is used to determine the TLS roles, following the proceduresin [RFC4572] (the 'active' endpoint will take the TLS client role).

The SDP setup attribute is not used to determine which endpoint initiates the SCTP association. Instead, both endpoints MUST

initiate the SCTP association, and MUST use the same SCTP port as client port and server port (in order to prevent two separate SCTP associations from being established).

However, if the proto field value is 'DTLS/SCTP', and the transport layer protocol is TCP (SCTP is carried on top of TCP), the SDP setup attribute is also used to negotiate which endpoint will initiate the TCP connection (send TCP SYN), following the procedures in [RFC4145].

7.3. SDP connection Attribute

The SDP connection attribute is used following the procedures in [RFC4145], with the additional SCTP specific considerations described in this section.

In general, the SDP connection attribute only applies to an SCTP association. Therefore, if the m- line proto field value is 'DTLS/SCTP', a connection attribute 'new' value will not automatically re-establish an existing DTLS connection, unless some DTLS properties are also changed in a way which require the DTLS connection to be re-established.

However, if the m- line proto field value is 'SCTP/DTLS', if the SCTP association is re-established, the DTLS connection also needs to be re-established.

OPEN ISSUE #2: Verify that the above statement regarding 'SCTP/DTLS' is correct.

8. SDP Offer/Answer Procedures

8.1. General

This section defines the SDP Offer/Answer [RFC3264] procedures for negotiating and establishing an SCTP association. Unless explicitly stated, the procedures apply to all protocol identifier values ('SCTP', 'SCTP/DTLS' and 'DTLS/SCTP') defined in this specification.

If the m- line proto value is 'SCTP/DTLS' or 'DTLS/SCTP', each endpoint MUST provide a certificate fingerprint, using the SDP 'fingerprint' attribute [RFC4145], if the endpoint supports, and is willing to use, a cipher suite with an associated certificate.

The authentication certificates are interpreted and validated as defined in [RFC4572]. Self-signed certificates can be used securely, provided that the integrity of the SDP description is assured as defined in [RFC4572].

NOTE: The procedures apply to a specific m- line describing an SCTP association. If an offer or answer contains multiple m- line describing SCTP associations, the procedures are applied separately to each m- line. The procedures related to SDP attributes apply to attributes associated with the m- line describing the SCTP association.

EDITOR'S NOTE: The offer/answer proceudres for the max-message-size value still need to be added.

8.2. Generating the Initial SDP Offer

When the offerer creates an offer, if the m- line proto field value is 'SCTP/DTLS' or 'DTLS/SCTP', the offerer MUST insert an SDP setup attribute in the offer, in order to determine the TLS roles, and in cases where SCTP is transported on TCP, determine which endpoint is responsible for establishing the TCP connection [Section 7.2].

The offerer MAY insert an SDP connection attribute, with a 'new' value, in the offer.

If the value of the m- line proto field is set to 'DTLS/SCTP', the offerer MAY insert an SDP sctp-port attribute, with a value indicating the local SCTP port, in the offer.

8.3. Generating the SDP Answer

When the answerer receives an offer, which contains an m- line describing an SCTP association, it MUST insert a corresponding m- line, with an identical m- line proto field value, in the associated answer, following the procedures in [RFC3264].

If the answerer accepts the offered m- line, it assigns the other m- line field values according to Section 4.

If the offer contains an SDP setup attribute, the answerer MUST insert a setup attribute in the answer, following the rules in [RFC4572] and [RFC4145] (if applicable).

If the value of the m- line proto field is set to 'DTLS/SCTP', the answerer MAY insert an SDP sctp-port attribute, with a value indicating the local SCTP port, in the answer.

Once the answerer has sent the answer, if the SCTP association associated with the m- line has yet not been established, or if an existing SCTP association is to be re-established, the answer MUST start establishing the SCTP association towards the peer.

If the answerer does not accept the m- line in the offer, it MUST assign a zero value to the port field of the corresponding m- line in the answer. In addition, the answerer MUST NOT insert an SDP setup attribute, or an SDP sctp-port attribute, in the answer.

8.4. Offerer Processing of the SDP Answer

When the offerer receives an answer, if the SCTP association associated with the m- line has not yet been established, or if an existing SCTP association is to be re-established, the offerer MUST start establishing the SCTP association towards the peer.

If the m- line port field value in the answer is zero, the offerer MUST terminate the SCTP association (if it exists) associated with the m- line.

8.5. Modifying the Session

When an offerer sends an updated offer, in order to modify a previously negotiated SCTP association, it follows the rules in Section 8.2, with the following exceptions:

If the offerer wants to re-establish an existing SCTP association associated with the m- line, the offerer MUST insert an SDP connection attribute, with a 'new' value, in the offer.

If the m- line proto field value is 'SCTP/DTLS' or 'DTLS/SCTP', and the offer is not intended to re-establish the DTLS connection, the offerer MUST NOT insert a SDP setup attribute with a value that changes the previously determined TLS roles in the offer.

If the offerer wants to disable a previously established SCTP association, it MUST set the port value of the m- line associated with the SCTP association to zero, following the procedures in [RFC3264]. The offerer MUST NOT insert an SDP setup attribute, or an SDP sctp-port attribute, in the offer.

NOTE: Different SCTP association applications might define protocol procedures etc that need to be performed before an SCTP association is terminated. Such procedures are outside the scope of this specification.

9. Multihoming Considerations

SCTP supports multihoming. An SCTP endpoint is considered multihomed if it has more than one IP address on which SCTP can be used. An SCTP endpoint inform the remote peer about its IP addresses using the address parameters in the INIT/INIT-ACK chunk. Therefore, when SDP

is used to describe an SCTP association, while the "c=" line contains the address which was used to negotiate the SCTP association, multihomed SCTP endpoints might end up using other IP addresses.

If an endpoint removes the IP address [RFC5061] that it offered in the SDP "c=" line associated with the SCTP association, it MUST send a new Offer, in which the "c=" line contains an IP address with is valid within the SCTP association.

NOTE: In some network environments, intermediaries performing gate- and firewall control use the address information in the SDP "c=" and "m=" lines to authorize media, and will not pass media sent using other addresses. In such network environment, if an SCTP endpoints wants to change the address information on which media is sent and received, it needs to send an updated Offer, in which the SDP "c=" and "m=" lines contain the new address information.

Multihoming is not supported when sending SCTP on top of DTLS, as DTLS does not expose address management to its upper layer.

10. NAT Considerations

10.1. General

SCTP features not present in UDP or TCP, including the checksum (CRC32c) value calculated on the whole packet (rather than just the header), and multihoming, introduce new challenges for NAT traversal. [I-D.ietf-behave-sctpnat] defines an SCTP specific variant of NAT, which provides similar features of Network Address and Port Translation (NAPT).

Current NATs typically do not support SCTP. [RFC6951] defines a mechanism for sending SCTP on top of UDP, which makes it possible to use SCTP with NATs and firewalls that do not support SCTP.

10.2. ICE Considerations

At the time of writing this specification, no procedures have been defined for using ICE ICE (Interactive Connectivity Establishment) [RFC5768] together with SCTP. Such procedures, including the associated SDP Offer/Answer procedures, are outside the scope of this specification, and might be defined in a future specification.

11. Examples

TODO: ADD EXAMPLES HERE

12. 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. security considerations on SCTP in general, while [RFC6083] defines security considerations when using DTLS on top of SCTP.

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

13. IANA Considerations

13.1. 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	SCTP	[RFCXXXX]
proto	SCTP/DTLS	[RFCXXXX]
proto	DTLS/SCTP	[RFCXXXX]

Table 1: SDP "proto" field values

13.2. 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,'sctp-port', as follows:

```
Attribute name:     sctp-port
Type of attribute:  media
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
```

13.3. 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 'SCTP', 'SCTP/DTLS' and '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" is required. It is defined in section Section 4.

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

association-usage Name: .The identifier of the subprotocol, as will be used in the <sctp-fmtp> subfield.

association-usage reference: A reference to the document in which the 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

Figure 1

14. Acknowledgments

The authors wish to thank Harald Alvestrand, Randell Jesup, Paul Kyzivat, Michael Tuexen for their comments and useful feedback.

15. References

15.1. Normative References

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15.2. Informative References

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[RFC6951] Tuexen, M. and R. Stewart, "UDP Encapsulation of Stream Control Transmission Protocol (SCTP) Packets for End-Host to End-Host Communication", RFC 6951, May 2013.

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