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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Infrastructure of audiovisual services – Communication procedures

Gateway control protocol: ITU-T H.248 support for control of SCTP bearer connections

Recommendation ITU-T H.248.97

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Recommendation ITU-T H.248.97

Gateway control protocol: ITU-T H.248 support for control of SCTP bearer connections

Summary

Recommendation ITU-T H.248.97 introduces support for stream control transmission protocol (SCTP) bearers in IP media gateways (MGs). It defines ITU-T H.248 packages that allow a media gateway controller (MGC) to control the establishment and the release of SCTP Associations with one of multiple SCTP Streams as well as SCTP reconfiguration procedures. This Recommendation defines a grouping semantics with a deaggregation stream that allows the partition of the protocol stack in two segments: on one side the SCTP Association and layers below, on the other side the individual SCTP Streams.

History

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Recommendation ITU-T H.248.97

Gateway control protocol: ITU-T H.248 support for control of SCTP bearer connections

1 Scope

This Recommendation details stream control transmission protocol (SCTP)-based bearer interfaces on ITU-T H.248 IP media gateways (MGs) . Such an ITU-T H.248 MG provides various functions for processing of SCTP packets, SCTP packet payload data (so-called SCTP DATA chunks) and functions related to SCTP protocol control information (based on called SCTP control chunks). This Recommendation focuses primarily on the aspect of SCTP Association control, which comprises the establishment and release of SCTP Associations, and the control, configuration and reconfiguration of SCTP Streams.

The Recommendation considers:

– SCTP transport modes, i.e., the multiple protocol stack options with an SCTP layer;

– connection and interworking models with a single or multiple SCTP Association endpoint(s) within an ITU T H.248 Context;

– SCTP Stream models concerning the mapping of multi-SCTP Stream structures on ITU-T H.248 Terminations;

– usage of ITU-T H.248 Stream grouping concept for SCTP; and

– new ITU-T H.248 packages for control of SCTP bearer connections.

Further, this Recommendation provides information on state modelling for MG-located connection endpoints related to SCTP Associations.

1.1 Applicability statements

Table 1 summarizes all possible SCTP-based interfaces of ITU-T H.248 entities, under the assumption of an underlying IP network, and their relevance for this Recommendation.

Table 1 – Main SCTP-based interfaces of ITU-T H.248 entities and their relevance for this Recommendation

SCTP-based transport	H.248 entity	Relevance
Call control interface (e.g., SIP-over-SCTP)	MGC	Out of scope of this Recommendation.
Gateway control interface (ITU-T H.248)	MGC, MG	Out of scope of this Recommendation. Possible ITU-T H.248 transport modes are indicated by [ITU-T H.248.67]. Usage of an SCTP-based ITU-T H.248 transport mode would be typically specified by an ITU-T H.248 profile as part of clause 6.12 in the profile definition template (see Appendix III in [ITU-T H.248.1]) and should be done in accordance with [ITU-T H.248.4].
Bearer interface	MG	Within the scope of this Recommendation.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T H.248.1] Recommendation ITU-T H.248.1 (2013), *Gateway control protocol: Version 3*.

[ITU-T H.248.4] Recommendation ITU-T H.248.4 (2009), *Gateway control protocol: Transport over Stream Control Transmission Protocol (SCTP)*.

[ITU-T H.248.67] Recommendation ITU-T H.248.67 (2009), *Gateway control protocol: Transport mode indication package*.

[ITU-T H.248.88] Recommendation ITU-T H.248.88 (2014), *Gateway control protocol: RTP topology dependent RTCP handling by ITU-T H.248 media gateways with IP terminations*.

[ITU-T H.248.89] Recommendation ITU-T H.248.89 (2014), *Gateway control protocol: TCP support packages*.

[ITU-T H.248.92] Recommendation ITU-T H.248.92 (2014), *Gateway control protocol: Stream endpoint interlinkage package*.

[ITU-T H.248.93] Recommendation ITU-T H.248.93 (2014), *Gateway control protocol: ITU-T H.248 support for control of transport security using the datagram transport layer (DTLS) protocol*.

[ITU-T H.248.94] Recommendation ITU-T H.248.94 (2015), *Gateway control protocol: Web-based real-time communication services – H.248 protocol support and profile guidelines*.

[ITU-T H.248.96] Recommendation ITU-T H.248.96 (2015), *Gateway control protocol: H.248 Stream grouping and aggregation*.

[ITU-T Q.1950] Recommendation ITU-T Q.1950 (2002), *Bearer independent call bearer control protocol*.

[ITU-T X.200] Recommendation ITU-T X.200 (1994), *Information technology – Open Systems Interconnection – Basic Reference Model: The basic model*.

[IETF RFC 4571] IETF RFC 4571 (2006), *Framing Real-time Transport Protocol (RTP) and RTP Control Protocol (RTCP) Packets over Connection-Oriented Transport*.

[IETF RFC 4960] IETF RFC 4960 (2007), *Stream Control Transmission Protocol*.

[IETF RFC 5061] IETF RFC 5061 (2007), *Stream Control Transmission Protocol (SCTP) Dynamic Address Reconfiguration*.

[IETF RFC 6525] IETF RFC 6525 (2012), *Stream Control Transmission Protocol (SCTP) Stream Reconfiguration*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 SCTP association [IETF RFC 4960]: 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.

3.1.2 SCTP chunk [IETF RFC 4960]: A unit of information within an SCTP packet, consisting of a chunk header and chunk-specific content.

3.1.3 SCTP endpoint [IETF RFC 4960]: The logical sender/receiver of SCTP packets. On a multi-homed host, an SCTP endpoint is represented to its peers as a combination of a set of eligible destination transport addresses to which SCTP packets can be sent and a set of eligible source transport addresses from which SCTP packets can be received. All transport addresses used by an SCTP endpoint must use the same port number, but can use multiple IP addresses. A transport address used by an SCTP endpoint must not be used by another SCTP endpoint. In other words, a transport address is unique to an SCTP endpoint.

3.1.4 SCTP packet [IETF RFC 4960]: The unit of data delivery across the interface between SCTP and the connectionless packet network (e.g., IP). An SCTP packet includes the common SCTP header, possible SCTP control chunks, and user data encapsulated within SCTP DATA chunks.

3.1.5 SCTP path [IETF RFC 4960]: The route taken by the SCTP packets sent by one *SCTP endpoint* to a specific destination transport address of its peer SCTP endpoint. Sending to different destination transport addresses does not necessarily guarantee getting separate paths.

3.1.6 SCTP stream [IETF RFC 4960]: 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.

NOTE – The relationship between Stream numbers in opposite directions is strictly a matter of how the applications use them. It is the responsibility of the SCTP user to create and manage these correlations if they are so desired.

3.1.7 SCTP user message (briefly 'SCTP message') [IETF RFC 4960]: Data submitted to SCTP by the Upper Layer Protocol (ULP).

3.1.8 transparent forwarding [ITU-T H.248.88]: MG packet forwarding behaviour with the characteristic of *Lx-PDU integrity*. This is a unidirectional characteristic of a Lx-PDU flow.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 SCTP transparent forwarding: MG packet forwarding behaviour with the characteristic of *SCTP-PDU integrity* (Notes 1, 2). This is a unidirectional characteristic.

NOTE 1 – An SCTP-PDU relates to an *SCTP packet*, see clause 3.1.4.

NOTE 2 – Definition based on clause 3.1.8, i.e., the characteristic of *PDU integrity* comprises the properties of *bit integrity* and *data integrity* (see also clauses 3.1.1, 3.1.2 and 3.2.3 in [ITU-T H.248.88]).

NOTE 3 – There is the characteristic of *SCTP packet integrity* in the context of "SCTP transparent forwarding". The MG might be SCTP aware; e.g., support of SCTP related statistics or Event detection would not violate transparent forwarding behaviour.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

BCP	Bearer Control Protocol
BFCP	Binary Floor Control Protocol
BICC	Bearer Independent Call Control
CLUE	Controlling multiple streams for telepresence (name of IETF working group on telepresence service)
DC	Data Channel
DCCP	Datagram Congestion Control Protocol
DCEP	Data Channel Establishment Protocol
DTLS	Datagram Transport Layer Security
GCP	Gateway Control Protocol
ICE	Interactive Connectivity Establishment
ID	Identifier
IP	Internet Protocol
IPv4	Internet Protocol Version 4
IPv6	Internet Protocol Version 6
ISUP	ISDN User Part
IWF	InterWorking Function
Lx	Layer number x
Lx+1	Layers above layer x
MG	Media Gateway
MGC	Media Gateway Controller
MSRP	Message Session Relay Protocol
NAT	Network Address Translation
PDU	Protocol Data Unit
SAP	Service Access Point
SCTP	Stream Control Transmission Protocol
SDP	Session Description Protocol
SEP	Stream Endpoint
SIP	Session Initiation Protocol
SSN	Signalling Sequence Number
TC	Transport Connection
TCP	Transmission Control Protocol
TLS	Transport Layer Security
TSN	Transmission Sequence Number
UDP	User Datagram Protocol

UE User Equipment

ULP Upper Layer Protocol

WebRTC Web Real-Time Communication

5 Conventions

5.1 Naming of Stream endpoints and Terminations

The notations "T*x*" and "T*x*(S*y*)" are used for naming of Terminations and Stream endpoints (SEPs) respectively, with:

– "T*x*" as *TerminationID* value;

– "S*y*" as *StreamID* value; and

– numerical variables *x* and *y*.

5.2 Conventions used in signalling flows

The following conventions are used in the example signalling flows:

SCTP Est.req
SCTP Est.ack Abstracted (SCTP message/procedure independent) representation for establishment requests/acknowledgements of new SCTP Associations.

SCTP Rel.req
SCTP Rel.ack Abstracted (protocol-independent) representation for release requests/acknowledgements of existing SCTP Associations.

5.3 SCTP bearer connection

The notation of *SCTP bearer connection* relates to an *SCTP Association* in the network user plane. There might also be an *SCTP Association* between media gateway controller (MGC) and MG in case of an SCTP-based ITU-T H.248 transport mode [ITU-T H.248.67] which is out of the scope of this Recommendation.

This Recommendation supports multiplexed SCTP Streams, i.e., multiple SCTP Streams per SCTP Association with the following model:

– one ITU-T H.248 SEP per SCTP Stream;

– one ITU-T H.248 SEP per SCTP Association;

– a deaggregation relationship between both types of SEPs.

In the case of unmultiplexed SCTP Streams, i.e., a 1:1 relation of SCTP Stream to SCTP Association is supported as a particular case of the above model. However, in scenarios where it is ensured that no more than one SCTP Stream exists during the life of the Association, a simplified model with a single SEP is also supported.

5.4 SCTP bearer control

There are connection control information flows for SCTP bearer connections in the network *user plane* (e.g., IP media/data/bearer plane) and in the ITU-T H.248 signalling. Figure 1 outlines the conventions used for the differentiation of both control flows.

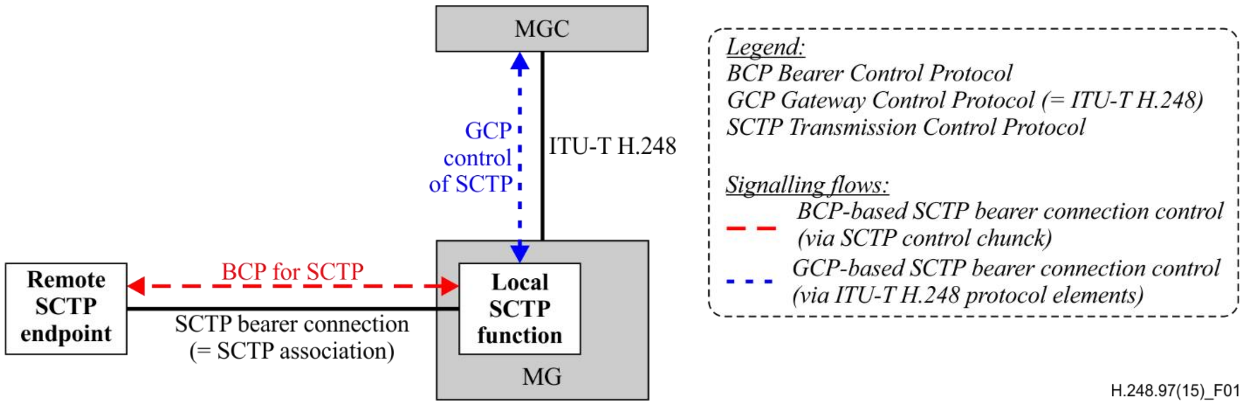

Figure 1 – Conventions for SCTP bearer control

5.5 SCTP endpoint notations

The notion of endpoint represents different concepts, see Figure 2.

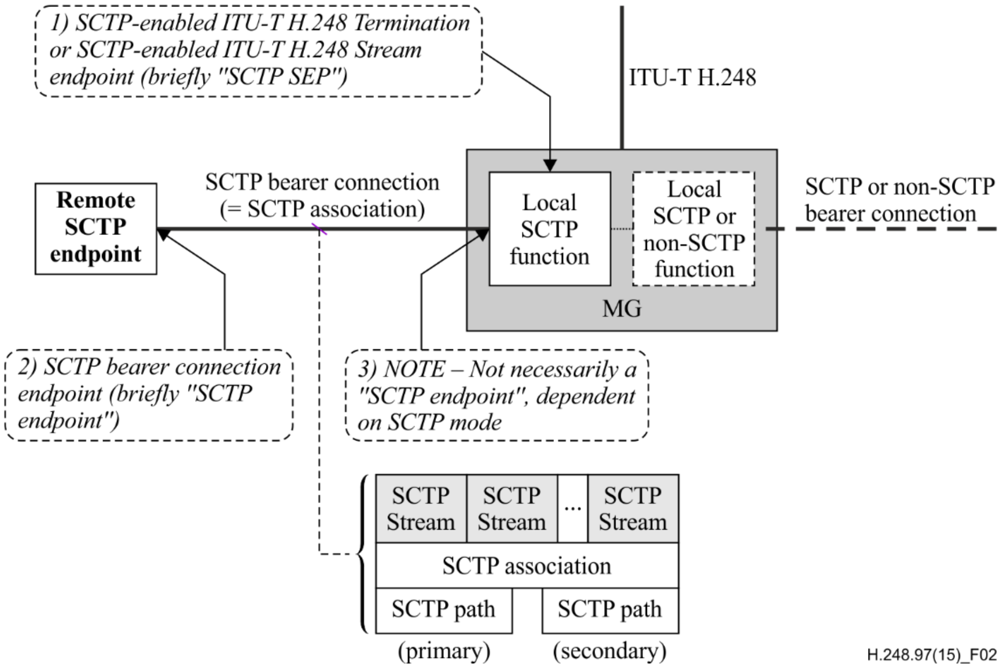

Figure 2 – Conventions for SCTP endpoint types

Usage in:

– *ITU-T H.248 control*: ITU-T H.248 Terminations/Stream endpoint with SCTP processing are denoted as SCTP-enabled Termination or SEP respectively;

– *user plane* (SCTP): an *SCTP bearer connection endpoint* is defined by the SCTP itself, see clause 3.1.3 "SCTP endpoint".

5.6 Protocol stack notation

When representing the layers of a protocol stack this Recommendation follows the same convention as the rest of the ITU-T H.248-series: a protocol layer is represented to the left of its lower protocol layer separated by a '/' character, e.g., L5/L4/L3.

NOTE – IETF RFCs usually follow the opposite convention: a protocol layer is represented to the right of its lower protocol layer, e.g., L3/L4/L5.

6 Use case descriptions

Basic use cases may be identified from the perspective of:

– transport type: based on the type of transport interworking, SCTP-to-SCTP gateway (see clause 6.2) or SCTP-to-non-SCTP gateway (see clause 6.3);

– service type: based on the application using SCTP and the service provided by the gateway (see clause 6.4).

Note that the various network use cases may be abstracted by a single bearer connection model, see clause 7.2.

6.1 Use cases related to SCTP transport modes

The SCTP protocol could be used in various transport protocol stacks or transport modes, see Figure 3.

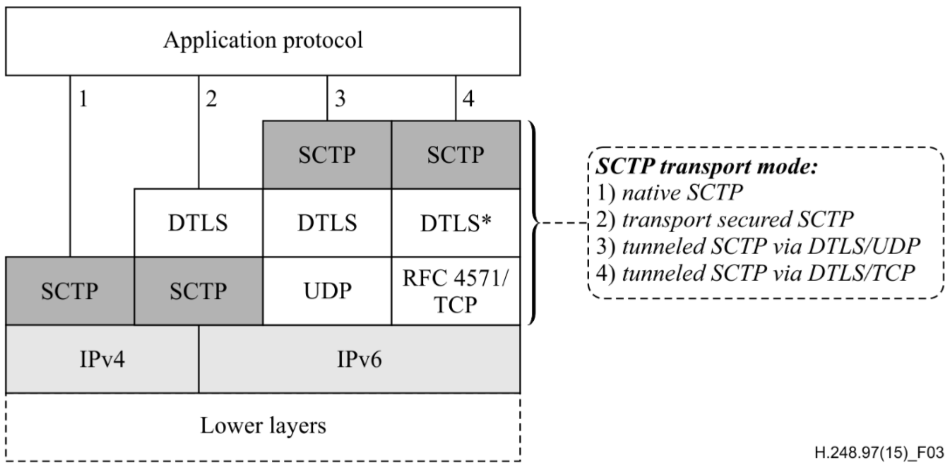

Figure 3 – SCTP transport modes

Referring to Figure 3, this Recommendation focuses on (3) tunnelled SCTP via datagram transport layer security (DTLS)/user datagram protocol (UDP) and (4) tunnelled SCTP via DTLS/transmission control protocol (TCP) (Note).

NOTE – The transport security protocol is labelled "DTLS*" in Figure 3 in order to emphasize the different behaviour of the DTLS layer when transported over TCP instead of UDP. There are open items for clarifications related to the operation of DTLS over TCP because "L4 = TCP" normally implies that 'TLS' and not 'DTLS' is the upper layer providing transport security. There are two possible options for the transport of DTLS over TCP:

Option 1: all DTLS protocol capabilities, which were added on top of TLS in order to address a non-assured L4 transport, are just *automatically disabled* when using TCP or switching from UDP to TCP.

Option 2: DTLS protocol capabilities are not explicitly disabled, they remain in place but will not be called e.g., due to the expectation that the TCP corrects packet loss by retransmissions of "DTLS/TCP" packets.

This Recommendation does not describe mechanisms to specify the use of one option or the other.

The use of TCP in this context implies a stack of three connection oriented protocol layers: SCTP, DTLS and TCP. Connection establishment procedures in one layer can only start when a connection on the lower layer is available. The MGC can sequentially use the connection establishment procedures of TCP [ITU-T H.248.89], DTLS [ITU-T H.248.93] and this Recommendation. Alternatively, it may use the interlinkage procedures defined in [ITU-T H.248 92].

6.2 Bearer connection network use cases with ITU-T H.248 IP-IP gateways

6.2.1 High-level interworking scenarios categories

The notion "IP-to-IP" (briefly "IP-IP") indicates an *(IP, IP) connection model* (as part of clause 6.4 in the profile definition template (see Appendix III in [ITU-T H.248.1])).

Each ITU-T H.248 SEP may be associated with a non-SCTP or different SCTP protocol stack variants, leading to various bearer network connection scenarios (see Figure 4).

SCTP to non-SCTP interworking:

– #1.1: an ITU-T H.248 IP-IP MG terminating/originating the native SCTP transport (stack SCTP/IP) and interworking with other, non-SCTP based IP transport protocols;

– #1.2: an ITU-T H.248 IP-IP MG terminating/originating DTLS-based secured transport over SCTP (stack "DTLS/SCTP/IP") and interworking to other, non-SCTP based IP transport protocols;

– #1.3: an ITU-T H.248 IP-IP MG terminating/originating the "DTLS/UDP" tunnel (or "DTLS/TCP" tunnel) with encapsulated SCTP (stack "SCTP/DTLS/UDP/IP" or "SCTP/DTLS/TCP/IP") and interworking to other, non-SCTP based IP transport protocols.

The three cases above require realization of an SCTP connection endpoint, i.e., full protocol termination.

SCTP to SCTP interworking with transport mode change:

– #2.1: an ITU-T H.248 IP-IP MG terminating/originating the DTLS-based secured transport over SCTP (stack "DTLS/SCTP/IP") and interworking to native SCTP;

– #2.2: an ITU-T H.248 IP-IP MG terminating/originating the "DTLS/UDP" tunnel (or "DTLS/TCP" tunnel) with encapsulated SCTP (stack "SCTP/DTLS/UDP/IP" or "SCTP/DTLS/TCP/IP") and interworking to native SCTP;

– #2.3: an ITU-T H.248 IP-IP MG terminating/originating the "DTLS/UDP" tunnel (or "DTLS/TCP" tunnel) with encapsulated SCTP (stack "SCTP/DTLS/UDP/IP" or "SCTP/DTLS/TCP/IP") at one side and terminating/originating DTLS-based secured transport over SCTP (stack "DTLS/SCTP/IP") at the other side and interworking between both;

– #2.4: an ITU-T H.248.IP-IP MG located in the middle of an end-to-end tunnelled SCTP via DTLS bearer connection with transport change from UDP to TCP (stack "SCTP/DTLS/UDP/IP" to "SCTP/DTLS/TCP/IP").

The change of transport mode in the cases above does not, per se, require a realization of an SCTP endpoint, i.e., termination of the SCTP protocol. However, depending on the type of interworking through the Context at the upper layer protocol (ULP), an SCTP endpoint realization may be required. This is the case at least in #2.1 and #2.3. In these cases neither SCTP packets nor SCTP user messages can be transparently forwarded and separate flow control at each endpoint is pertinent.

SCTP to SCTP without transport mode change:

– #3.1: an ITU-T H.248 IP-IP MG located in the middle of an end-to-end SCTP bearer connection, there are two sub-variants:

  • #3.1.1: the end-to-end SCTP bearer connection is divided in two separate SCTP Associations ("SCTP proxy mode");

  • #3.1.2: the end-to-end SCTP bearer connection relates to a single SCTP Association ("SCTP relay mode").

– #3.2: an ITU-T H.248 IP-IP MG located in the middle of an end-to-end transport secured DTLS/SCTP bearer connection, there are two sub-variants:
  - #3.2.1: SCTP transparent forwarding;
  - #3.2.2: DTLS/SCTP to DTLS*/SCTP forwarding between different security domains (i.e., there are two DTLS sessions with not necessarily equal security settings).
– #3.3: an ITU-T H.248 IP-IP MG located in the middle of an end-to-end tunnelled SCTP via DTLS/UDP or DTLS/TCP (stack "SCTP/DTLS/UDP/IP" or "SCTP/DTLS/TCP/IP") bearer connection.

NOTE 1 – E.g., following interworking scenario given by "MSRP over web real-time communication (WebRTC) data channels (DCs) (see [b-IETF data-channel-msrp], [b-IETF sdpneg])" and a DTLS encapsulation of SCTP based on [b-IETF sctp-dtls-encaps].

Case #3.1.1 implies realization of SCTP endpoints at both sides of the Context. Case #3.2.2 will also normally require realization of an SCTP endpoint. The rest of the cases under this header may represent SCTP transparent forwarding and thus not require any SCTP related ITU-T H.248 control procedures.

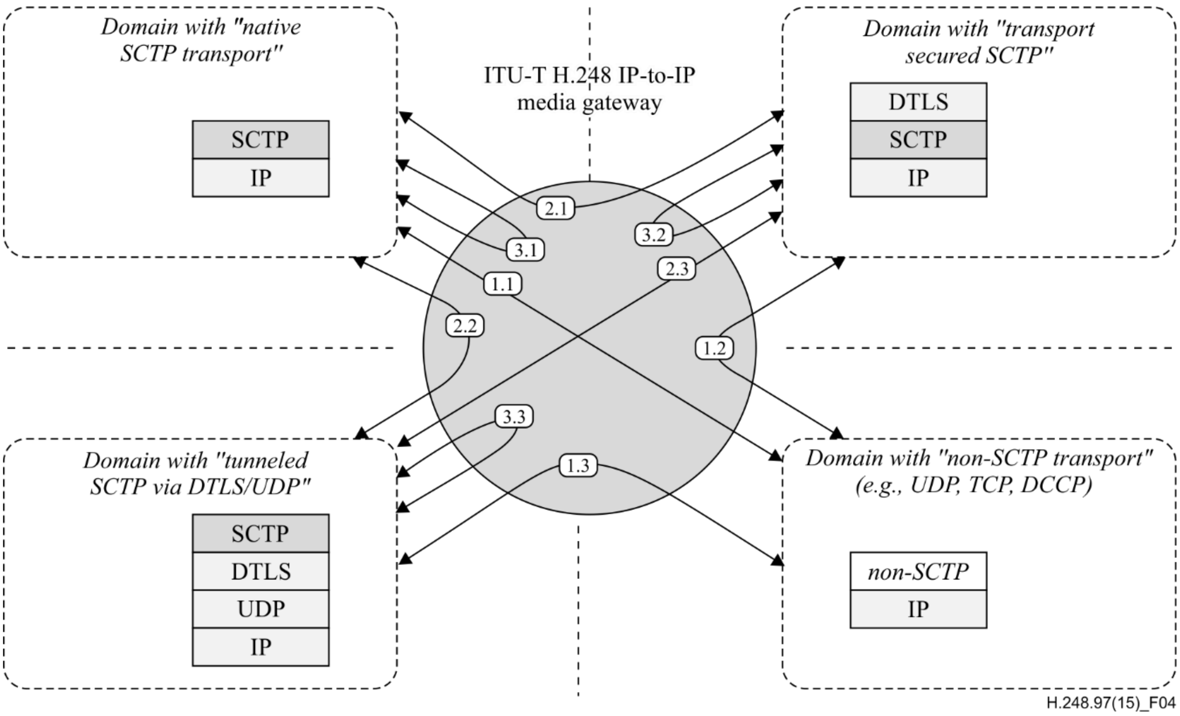

Figure 4 – Bearer connection network use cases with ITU-T H.248 IP-IP gateways

NOTE 2 – Figure 4 does not show tunnelled SCTP over DTLS/TCP (case #2.4 above).

Application protocol perspective:

The application protocol relates to the upper layer protocol(s) on top of the SCTP transport. Most of the above scenarios are basically of type "application-agnostic", but some of them are "application-aware" and involve application related ITU- T H.248 signalling (see clause 6.2.2.1).

6.2.2 Interworking scenarios variations

6.2.2.1 "SCTP-to-SCTP application aware processing"

The case #3.2.2 scenario implies application awareness since DTLS, being the SCTP upper layer, requires bearer control procedures. There exist variations of scenario cases #3.1.1 and #3.3 where the MG may also be required to be application aware in case of additional operations on the upper protocol layer(s) which imply knowledge about the carried application. Such MG operations might be related to the detection of an Event, the generation of statistics, the modification of protocol data units (PDUs), etc.

6.2.2.2 SCTP Associations in single-SCTP-Stream or multi-SCTP-Stream mode

The served user instance of SCTP Associations may use a single bidirectional SCTP Stream (i.e., a pair of unidirectional SCTP Streams) or multiple instances thereof (e.g., multiple WebRTC data channels). There might be correspondent use case variations.

6.3 Bearer connection network use cases with ITU-T H.248 "SCTP to non-SCTP" gateways

Relate to scenario cases #1.1, #1.2 and #1.3.

Example: WebRTC data channel interworking as illustrated in Appendix I.3 of [ITU-T H.248.93], where all of the examples relate to case #1.3.

6.4 Supported use cases by this Recommendation

The first release of this Recommendation provides ITU-T H.248 support for use cases related to the following communication services in network environments with ITU-T H.248 gateway involvement (Table 2):

Table 2 – Supported use cases by this Recommendation

Communication service	ITU-T H.248 MG type	Bearer connection network use case(s)
WebRTC stack component "data channel"	ITU-T H.248 WebRTC gateway (see [ITU-T H.248.94])	Cases: #1.3 and #2.2
Telepresence stack component "data channel"	ITU-T H.248 media server	Cases: #1.3, #2.2, #3.3

7 Models

7.1 Network model from ITU-T H.248 entity point of view

The following network model (Figure 5) illustrates the relevant areas covered by this Recommendation. The ITU-T H.248 MG peers with an SCTP-capable IP host remote endpoint.

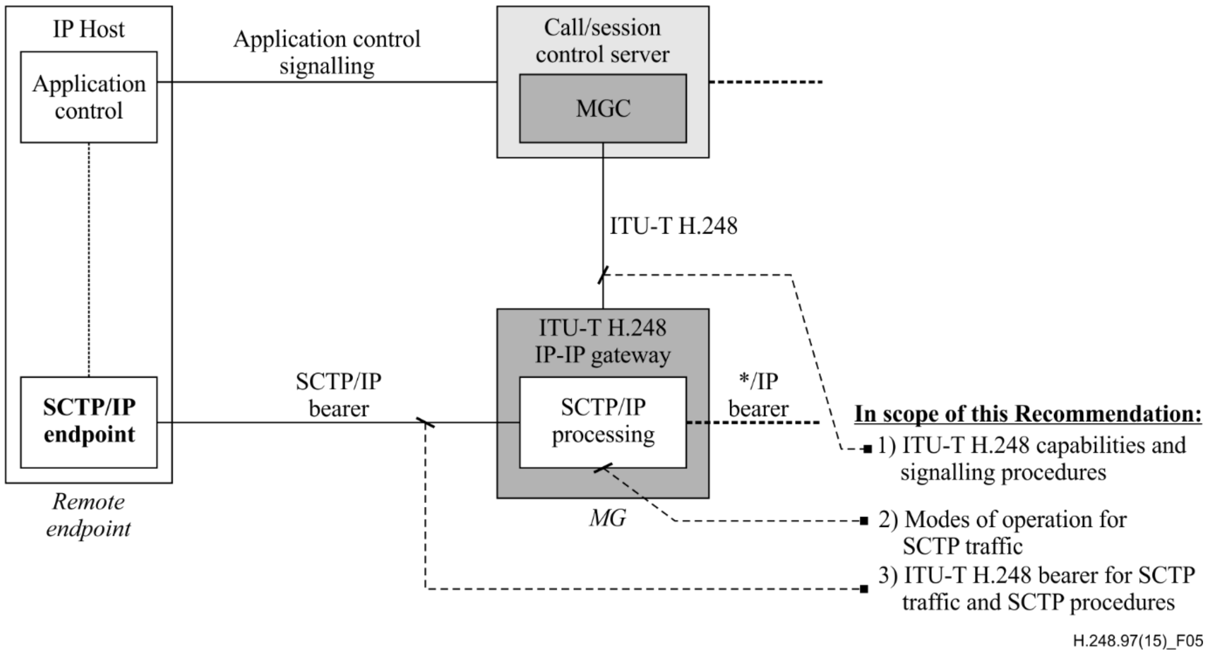

Figure 5 – Network model from ITU-T H.248 entity point of view ("half-call/bearer connection model")

This Recommendation primarily addresses:

– signalling capabilities and procedures at the ITU-T H.248 interface;

– aspects and control of SCTP modes of operation in the ITU-T H.248 MG; and

– configuration and procedures of the native "SCTP/IP" or tunnelled "SCTP/tunnel/IP" protocol stack for ITU-T H.248-controlled bearers.

7.2 ITU-T H.248 model for SCTP multi-Stream

One SCTP Association may consist of multiple SCTP Streams, up to 65535. The mapping of SCTP Streams within one SCTP Association to ITU-T H.248 Streams could theoretically be done in the following different ways:

– all SCTP Streams are mapped to the same ITU-T H.248 Stream;

– each SCTP Stream is mapped to one ITU-T H.248 Stream within the same Termination;

– each SCTP Stream is mapped to one ITU-T H.248 Stream in a separate Termination.

7.2.1 One ITU-T H.248 Stream per SCTP Stream

WebRTC and controlling multiple streams for telepresence (CLUE), which are supported by this Recommendation, use a "data channel" that consists of one single SCTP Stream in each direction.

WebRTC allows for multiple data channels within one WebRTC session, and thus multiple SCTP Streams in each direction over the same SCTP Association. In the general case, these different data channels will carry different types of SCTP user messages as there may be different application protocols as users of SCTP. For example, one data channel may be used for instant text messaging and one for game control information. Therefore, in the general case they may be subject to different processing by the MG and require different control actions by the MGC with ITU-T H.248. They may also interwork differently with the other side of the session, for example having a different transport protocol stack mapping in the Context.

CLUE only describes the use of one data channel per CLUE session (see also Figure 9).

To facilitate the different handling of different data channels within the ITU-T H.248 Context, this Recommendation only considers the handling of one SCTP Stream in each direction per ITU-T H.248 Stream. All ITU-T H.248 Streams related to the same endpoint of an SCTP Association are part of the same Termination.

7.2.1.1 SCTP Streams vs. ITU-T H.248 Streams dynamics

An SCTP Association may be created with a much higher number of SCTP Streams than what is actually needed. [b-IETF webrtc-datachann] recommends negotiating 65535 Streams. This is the maximum number available (due to the 16-bit *Stream Identifier* element in the DATA chunk header, see section 3.1.1 of [IETF RFC 4960]).

Creating such a number of ITU-T H.248 Streams would consume resources unnecessarily. Therefore, although this Recommendation does not restrict the number of ITU-T H.248 Streams to be created initially, i.e., at the time of establishment of the SCTP Association, it is recommended that the MGC only creates ITU-T H.248 Streams for those SCTP Streams that will start to send or receive SCTP user messages.

All ITU-T H.248 SEPs corresponding to SCTP Streams which are part of the same SCTP Association belong to the same Termination. This allows for MGC control actions at SCTP Association level, e.g., start an Association.

7.2.2 One ITU-T H.248 Stream for all SCTP Streams

When SCTP is used for the transport of signalling protocols (e.g., bearer independent call control (BICC), ISDN user part (ISUP), ITU-T H.248) all user messages over an SCTP Association are of the same nature. The use of multiple SCTP Streams is motivated in order to avoid head-of-line blocking problems, i.e., lost or delayed single message blocks or delay of all traffic. These types of applications usually utilize a high number of SCTP Streams with a balanced load distribution.

If an MGC were responsible to control an SCTP Association in an MG for this purpose, the use of separate ITU-T H.248 Stream per SCTP Stream would cause unnecessary overhead. Therefore, one single ITU-T H.248 Stream could be enough for all SCTP Streams.

However, this case is out of scope of this Recommendation.

7.3 Bearer connection model

7.3.1 Model for a Context with a single SCTP Termination

Figure 6 details the generic connection-model where an SCTP-enabled Termination is connected to another single Termination which is not SCTP-enabled.

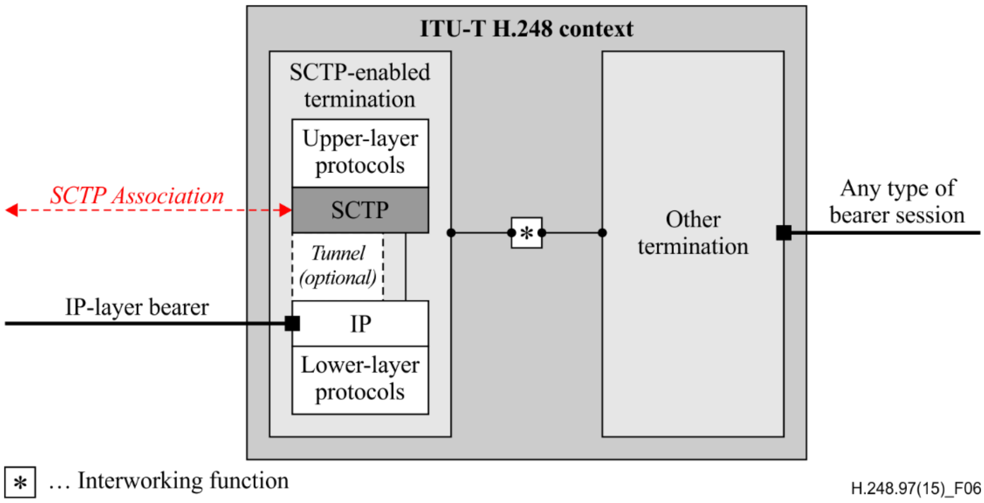

Figure 6 – Two-Termination Context with scope on a single SCTP Termination only

7.3.2 Model for a Context with two SCTP Terminations

Figure 7 represents the general ITU-T H.248 (SCTP, SCTP) connection model, i.e., a two-Termination-Context with both Terminations enabled for SCTP. The type of interworking function (IWF) determines the particular MG behaviour concerning SCTP handling.

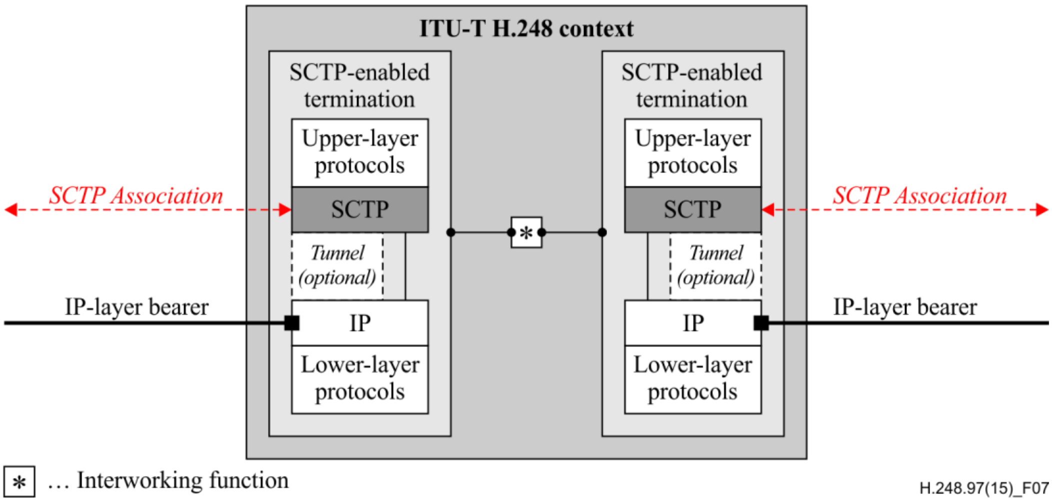

Figure 7 – Two-Termination Context with Context-level SCTP scope

7.4 Protocol stack model for mapping of SCTP Streams to applications

The SCTP layer represents an SCTP Association which offers multiple SCTP Streams for application data traffic transport (Figure 8). The SCTP Stream identifier could be considered as service access point (SAP) for the upper-layer protocol (or more precisely: the *SCTP StreamID* represents the *(SCTP)-service-access-point-address* according to [ITU-T X.200]).

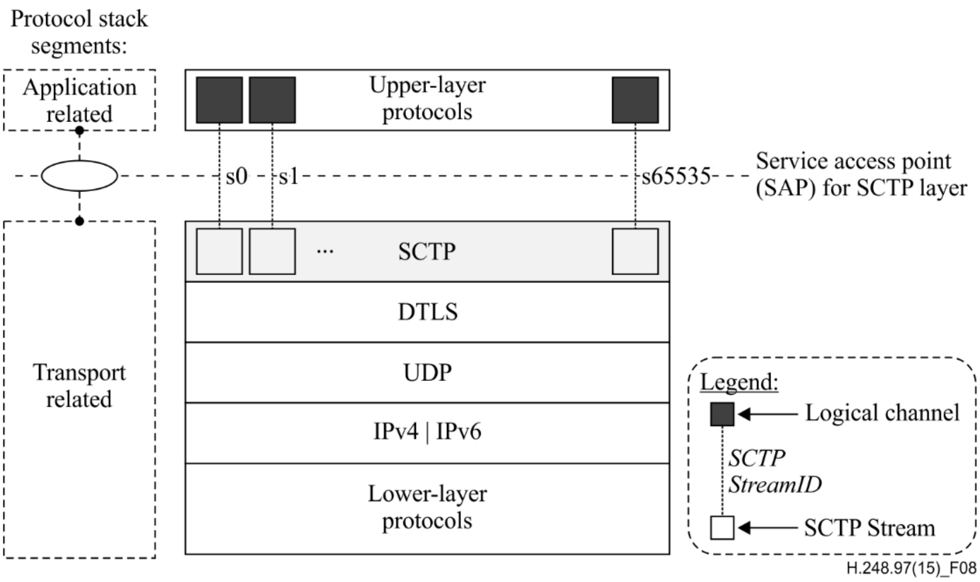

Figure 8 – Generic protocol stack model for mapping of SCTP Streams to applications (example shown: SCTP transport mode "tunnelled SCTP via DTLS/UDP")

Figure 9 illustrates example SCTP Stream configurations for communication services: WebRTC and telepresence.

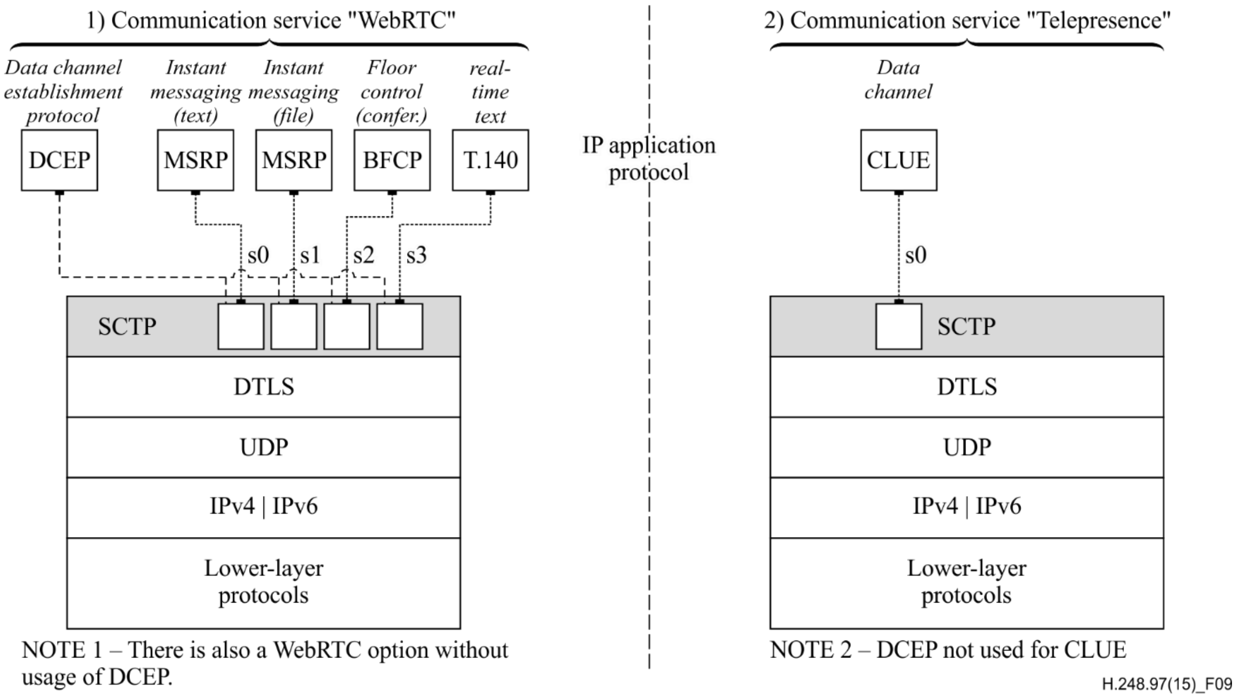

Figure 9 – Example protocol stack model for communication services WebRTC and telepresence

8 SCTP basic connection control package(s)

Package name: SCTP basic connection control package

Package ID: sctpbcc (0x0121)

Description: This package provides the functionality to establish and release an SCTP bearer connection.

Version: 1

Extends: None

8.1 Properties

8.1.1 Incoming bearer connection establishment blocking

Property name: Incoming bearer connection establishment blocking

Property ID: bceb (0x0001)

Description: This property defines the MG availability to accept or reject incoming SCTP bearer connection establishment procedures.

NOTE – See Annex A concerning a state model based illustration.

Type: Enumeration

Possible values: See Table 3.

Table 3 – Bearer connection establishment preparedness (of SCTP endpoints)

<table>
<tr><th>Value</th><th>MG behaviour</th></tr>
<tr><td>"blocked"
(0x0001)</td><td>– Any incoming SCTP message shall be silently discarded e.g., an SCTP INIT chunk shall not be acknowledged (NOTE).
– Any outgoing SCTP Association control procedure is not affected:
• Signal sctpbcc/EstBNC triggers the start of an SCTP Association establishment procedure by sending an SCTP INIT chunk.
• An interlinkage procedure [ITU-T.H.248.92] triggers the start of an SCTP Association establishment procedure by sending an SCTP INIT chunk.</td></tr>
<tr><td>"unblocked"
(0x0002)</td><td>– Incoming SCTP messages are processed. An incoming SCTP INIT chunk is acknowledged.
– Any outgoing SCTP Association control procedure is not affected:
• Signal sctpbcc/EstBNC triggers the start of an SCTP Association establishment procedure by sending an SCTP INIT chunk.
• An interlinkage procedure [ITU-T.H.248.92] triggers the start of an SCTP Association establishment procedure by sending an SCTP INIT chunk.</td></tr>
<tr><td colspan="2">NOTE – The purpose of this value is to block incoming SCTP Association establishment procedures. Once the SCTP Association is established it has no effect on incoming data SCTP chunks.</td></tr>
</table>

Default: "Unblocked"

NOTE – ITU-T H.248 profile specifications could redefine other default values.

Defined in: LocalControl

Characteristics: Read/Write

8.1.2 SCTP StreamID

Property name: SCTP StreamID

Property ID: sctpid (0x0002)

Description: This property assigns an SCTP StreamID to an ITU-T H.248 Stream. A single SCTP StreamID in the sub-list indicates that it applies to both the Local and Remote directions. The use of two SCTP StreamIDs allows a different SCTP StreamID in either direction. The first position relates to the Local(Receive) direction. The second position relates to the Remote (Send) direction.

Type: Sub-list of Integer

Possible values: 0-65536

Values 0 - 65535 denote a valid SCTP StreamID

Value 65536 is only used when the sub-list is of length two to denote that an SCTP Stream has not been assigned to a particular direction

Default: None

Defined in: LocalControl

Characteristics: Read/Write

8.2 Events

8.2.1 SCTP connection state change ("BNC Change")

Event name: SCTP connection state change

Event ID: BNCChange (0x0001)

Description: This Event occurs whenever a change to a (SCTP) bearer network connection occurs. For example, a bearer has been established or a bearer has been released.

The Event is related to a simplified state transitioning model, in contrast to [IETF RFC 4960] ,which is described in Annex A.

NOTE – The Event design is aligned with Event *gb/BNCChange* according clause A.6.2.1 of [ITU-T Q.1950] by using an Event-/signal-based approach for connection establishment/release control.

8.2.1.1 EventsDescriptor parameters

8.2.1.1.1 Type of state change

Parameter name: Type of state change

Parameter ID: Type (0x0001)

Description: The type of state transitioning, given by the state after the transition.

Type: Sub-list of Enumeration

Optional: Yes

Possible values: Table 4 defines the protocol semantic per value:

Table 4 – Semantic of parameter *Type*

Value	Name	Final state (Figure A.2)	Semantic
Est [0x01]	Bearer Established	ESTABLISHED	Notify MGC successful SCTP bearer connection establishment.
Rel [0x05]	Bearer Released	IDLE	Notify MGC successful SCTP bearer connection release.
NOTE – The numerical codepoint assignments are aligned with [ITU-T Q.1950].			

Default: Detect ALL

8.2.1.2 ObservedEventsDescriptor parameters

8.2.1.2.1 Type of state change

Parameter name: Type of state change

Parameter ID: Type (0x0001)

Description: This is used to indicate what change has occurred to the SCTP bearer connection.

Type: Enumeration

Optional: No

Possible values: Est [0x01] Bearer Established
Rel [0x05] Bearer Released

Default: None

8.3 Signals

The Signals are related to a simplified state transitioning model, in contrast to [IETF RFC 4960], which is described in Annex A.

8.3.1 Establish (BNC)

Signal name: Establish BNC

Signal ID: EstBNC (0x0001)

Description: This Signal triggers the bearer control function to start bearer establishment (i.e., this Signal is used to initiate the SCTP bearer connection establishment: the MG takes the SCTP initiator role, sends an SCTP INIT chunk and completes the SCTP establishment procedure from SCTP state $\text{CLOSED}_{\text{SCTP}}$ to SCTP state $\text{ESTABLISHED}_{\text{SCTP}}$).

This Signal takes effect only in ITU-T H.248 connection states $\text{IDLE}_{\text{H.248}}$ and $\text{BLOCKED}_{\text{H.248}}$ (and would be replied by an error code when in ITU-T H.248 connection state $\text{ESTABLISHED}_{\text{H.248}}$).

Signal type: Brief

Duration: Not applicable

8.3.1.1 Additional parameters

None.

8.3.2 Release (BNC)

Signal name: Release BNC

Signal ID: RelBNC (0x0002)

Description: This Signal triggers the bearer control function to send bearer release (i.e., this Signal is used to initiate the SCTP shutdown procedure(s): the MG sends an SCTP SHUTDOWN chunk and completes the SCTP shutdown procedure from SCTP state $\text{ESTABLISHED}_{\text{SCTP}}$ to SCTP state $\text{CLOSED}_{\text{SCTP}}$).

This Signal only takes effect in ITU-T H.248 connection state $\text{ESTABLISHED}_{\text{H.248}}$ (and would be replied by an error code when in ITU-T H.248 connection states $\text{BLOCKED}_{\text{H.248}}$ or $\text{IDLE}_{\text{H.248}}$).

Signal type: Brief

Duration: Not applicable

8.3.2.1 Additional parameters

None.

8.4 Statistics

None.

8.5 Error codes

None.

8.6 Procedures

8.6.1 SCTP endpoint creation

8.6.1.1 Use of the package with deaggregation

When more than one SCTP Stream is expected during the lifecycle of the SCTP Association, the use of this package requires the creation of multiple ITU-T H.248 Streams:

– one deaggregation stream that represents the SCTP Association as a whole, as well as the lower protocol layers;

NOTE – A hierarchical deaggregation where a second deaggregation stream is defined to represent the transport layer below SCTP is for further study (see also clause 11.3).

– one component stream per SCTP Stream.

The component stream(s) may be created at the same time as the deaggregation stream or at a later point in time. The MGC shall bind the ITU-T H.248 component stream(s) to the SCTP Stream(s) by setting the *sctpid* property of the component stream(s) to the SCTP StreamID(s) of the corresponding SCTP Stream(s) in order for SCTP messages to flow between the deaggregation stream and the component stream.

Incoming SCTP messages are only delivered from the deaggregation stream to a component stream if the component stream has the *sctpid* property set to the value matching the SCTP StreamID of the incoming SCTP message.

A component stream can only deliver outgoing SCTP messages to the deaggregation stream if the *sctpid* property of the component stream is set to a valid SCTP StreamID value.

This Recommendation does not define any mechanisms to support the negotiation of SCTP StreamIDs with the peer. In order for the MGC to correctly set the *sctpid* property, a negotiation must take place either:

a) out-of-band, e.g., with the session initiation protocol (SIP). This is the case for CLUE applications [b-IETF cluechann]; or

b) in-band with the use of the data channel establishment protocol (DCEP). This is the case for WebRTC. [ITU-T H.248.94] specifies a mechanism that allows the sending and reception of DCEP messages.

Other mechanisms are for further study.

The use of deaggregation, as described, is also possible in the case of a single SCTP Stream.

The MGC shall not set the *sctpid* property in the deaggregation stream.

8.6.1.2 Use of the package without deaggregation

When there is a prior knowledge in the MGC that only one SCTP Stream is needed during the lifecycle of the SCTP Association, the MGC may choose not to use deaggregation.

In this case one single ITU-T H.248 Stream represents both the SCTP Association and lower layers and the SCTP Stream. The MGC shall set the *sctpid* property in this ITU-T H.248 Stream.

8.6.2 SCTP bearer connection establishment

8.6.2.1 Use of the package with deaggregation

In order to establish an SCTP Association, the MGC shall order the *EstBNC* signal on the deaggregation stream. The MG shall then initiate the SCTP Association establishment by sending an INIT chunk.

The SCTP Association may also be initiated by the peer. The MG is ready to accept and complete an SCTP Association establishment initiated by the peer as soon as the deaggregation stream has been created.

The MGC may prevent an SCTP Association establishment initiated by the peer by setting the *bceb* property to "blocked" in the deaggregation stream.

The MGC should preferably arm the *BNCChange* Event. Once the 4-way establishment handshake has been completed successfully, the MG shall notify the MGC with the *BNCChange* Event, if this has been set by the MGC in the deaggregation stream.

8.6.2.2 Use of the package without deaggregation

When no deaggregation is used, the *EstBNC* signal, the *BNCChange* Event and the *bceb* property are used as above on the ITU-T H.248 Stream representing the SCTP Association and SCTP Stream.

8.6.2.3 DTLS L4 connectivity

When SCTP is used upon DTLS, as in the WebRTC and CLUE use cases, a DTLS connection must be available before the SCTP Association establishment can be initiated.

The MGC shall use the connection establishment procedures defined in [ITU-T H.248.93] prior to the SCTP Association procedures. Alternatively, the MGC may use the interlinkage procedures defined in [ITU-T H.248.92] to automatically trigger SCTP Association establishment upon completion of the DTLS connectivity.

8.6.3 SCTP application data transfer

8.6.3.1 MG external

The SCTP bearer connection is ready for application data transfer when remote and local SCTP endpoints are both transitioned to SCTP Association state "ESTABLISHED" (see Figure 3 of [IETF RFC 4960]).

The StreamMode property of the LocalControl Descriptor affects the application data flow rather than the SCTP control information used to establish or close the SCTP Association. The requested MG behaviour is defined by Table 5:

Table 5 – Impact of StreamMode on SCTP bearer traffic at external MG interface

Traffic direction	StreamMode settings	MG behaviour
Outgoing	Sending enabled (i.e., values *SendOnly*, *SendRecv*, *LoopBack*)	All SCTP packets sent.
	Sending disabled (i.e., values *RecvOnly*, *Inactive*)	Only SCTP packets with SCTP control chunks are sent (optional piggybacked SCTP data chunks would be removed). SCTP packets with SCTP data chunks only are blocked.
Incoming	Receiving enabled (i.e., values *RecvOnly*, *SendRecv*, *LoopBack*)	All SCTP packets accepted.
	Receiving disabled (i.e., values *SendOnly*, *Inactive*)	Only SCTP packets with SCTP control chunks are accepted (optional piggybacked SCTP data chunks would be removed). SCTP packets with SCTP data chunks only are blocked.

When deaggregation is used, SCTP user messages can only flow between the deaggregation stream and a component stream if the *sctpid* property of the component stream is set correctly.

If there is no component stream with the *sctpid* property matching the SCTP StreamID of the received message, the deaggregation stream is not obliged to buffer the SCTP user message and may drop it.

Other Recommendations may specify the handling of some SCTP user messages during the data transfer phase on the deaggregation stream. [ITU-T H.248.94] specifies the handling of DCEP messages on the deaggregation stream.

8.6.4 Connectivity with other SEP in the Context

The connectivity with other SEPs in the Context follows the general ITU-T H.248 principles, i.e., it is controlled by the Topology Descriptor and the StreamMode property.

8.6.4.1 Use of deaggregation

When deaggregation is used, one or more component streams shall be created. The connectivity to the other SEP in the Context is realized via the component stream(s). In order for application messages to flow between the SEPs in the Context, there must be a bothway topology on the component stream between both SEPs. The MGC should set the topology before SCTP messages are expected to flow through the Context in order to avoid loss of messages.

For example, in case of SCTP to TCP interworking, a bothway (or eventually oneway) topology must have been defined between both Terminations on the ITU-T H.248 Stream which is the component stream at the SCTP side before SCTP messages are forwarded internally through the Context.

This Recommendation does not mandate the buffering of SCTP incoming or outgoing user messages when there is no internal connectivity through the Context, or when there is no component stream with a matching *sctpid*. However, other Recommendations may advise a short-term buffering for specific cases (see [ITU-T H.248.94]).

8.6.4.2 No use of deaggregation

When one ITU-T H.248 Stream is used to represent both the SCTP Association and the SCTP Stream, SCTP user messages are transferred through the Context if there is connectivity with the other SEP, as defined by the Topology Descriptor. Only SCTP user messages are transferred between the SEPs.

8.6.5 SCTP bearer connection release

In order to initiate a shutdown of the SCTP Association the MGC shall order Signal *RelBNC* on the ITU-T H.248 Stream representing the SCTP Association. When deaggregation is used, this is the deaggregation stream.

If the MGC orders the subtraction of the SEP representing the SCTP Association, and an SCTP Association shutdown has not been completed, the MG should preferably send an ABORT to the peer before removing the SEP.

When deaggregation is used the removal of all component streams shall not trigger the closure of the SCTP Association.

9 SCTP Reconfiguration Stream Reset Package

Package name: SCTP Reconfiguration Stream Reset Package

Package ID: sctpreset, (0x0122)

Description: This package allows the MG to support the SCTP Stream configuration procedures for "Outgoing signalling sequence number (SSN) Reset Request" defined in [IETF RFC 6525].

Version: 1

Extends: sctpbcc

9.1 Properties

None.

9.2 Events

9.2.1 Detect outgoing SCTP Stream reset

Event name: Detect outgoing SCTP Stream reset

Event ID: detreset (0x0001)

Description: This Event allows the MG to detect outgoing SCTP Stream reset requests from remote peers. It allows the MGC to be notified of the reception of an outgoing SCTP Stream reset and to respond to the request. Alternatively, it allows the MG to autonomously respond to the outgoing SCTP Stream reset by sending its own response.

9.2.1.1 EventsDescriptor parameters

9.2.1.1.1 Outgoing Stream Reset Response

Parameter name: Outgoing Stream Reset Response

Parameter ID: outresp (0x0001)

Description: This parameter indicates to the MG whether it should respond autonomously to the reception of a valid outgoing SCTP Stream reset from the remote peer by initiating its own outgoing SCTP Stream reset.

Type: Enumeration

Optional: Yes

Possible values:	"accept"	The MG shall accept the outgoing SCTP Stream reset request and apply the procedures from section 5.2.2 of [IETF RFC 6525].
	"deny"	The MG shall deny the outgoing SCTP Stream reset request from section 5.2.1 of [IETF RFC 6525].
	"mgc"	The MG shall wait for an "Outgoing SCTP Stream Reset Response" (*sctpreset/resetresp*) Signal indicating the action to take before sending a reconfiguration response.

Default: "accept"

9.2.1.2 ObservedEventsDescriptor parameters

9.2.1.2.1 SCTP StreamID

Parameter name: SCTP StreamID

Parameter ID: sctpid (0x0001)

Description: This parameter indicates the SCTP StreamID(s) that the outgoing SCTP Stream reset request was sent for.

Type: Sub-list of Integer

Optional: No

Possible values: 0 - 65535

Default: None

9.2.2 Outgoing SCTP Stream Reset Result

Event name: Outgoing SCTP Stream Reset Result

Event ID: result (0x0002)

Description: This Event indicates the result of an outgoing SCTP Stream reset sent to the remote peer (i.e., by the "Initiate Outgoing SCTP Stream Reset" (*sctpreset/initreset*) Signal).

9.2.2.1 EventsDescriptor parameters

None.

9.2.2.2 ObservedEventsDescriptor parameters

9.2.2.2.1 SCTP StreamID

Parameter name: SCTP StreamID

Parameter ID: sctpid (0x0001)

Description: This parameter indicates the SCTP StreamID(s) contained in the reconfiguration response to the original outgoing SCTP Stream reset request.

Type: Sub-list of Integer

Optional: No

Possible values: 0 - 65535

Default: None

9.2.2.2.2 Result

Parameter name: Result

Parameter ID: result (0x0002)

Description: This parameter indicates the result to an outgoing SCTP Stream reset request received in a reconfiguration response from the remote peer.

Type: Integer

Optional: No

Possible values: As per "Result" in section 4.4 of [IETF RFC 6525].

Default: None

9.3 Signals

9.3.1 Initiate Outgoing SCTP Stream Reset

Signal name: Initiate Outgoing SCTP Stream Reset

Signal ID: initreset (0x0001)

Description: This Signal requests the MG to send an outgoing SSN Reset Request according to the procedures in section 5.1.2 of [IETF RFC 6525].

Signal type: Brief

Duration: Not applicable

9.3.1.1 Additional parameters

9.3.1.1.1 SCTP StreamID

Parameter name: SCTP StreamID

Parameter ID: sctpid (0x0001)

Description: This parameter indicates the SCTP StreamID(s) to which the outgoing reset request applies.

Type: Sub-list of Integer

Optional: No

Possible values: 0 - 65535

Default: None

9.3.2 Outgoing SCTP Stream Reset Response

Signal name: Outgoing SCTP Stream Reset Response

Signal ID: resetresp (0x0002)

Description: This Signal indicates the action that the MG shall take in response to receiving an outgoing SCTP Stream reset request from the remote peer.

Signal type: Brief

Duration: Not applicable

9.3.2.1 Additional parameters

9.3.2.1.1 SCTP StreamID

Parameter name: SCTP StreamID

Parameter ID: sctpid (0x0001)

Description: This parameter indicates the SCTP StreamID(s) that the configuration response relates to.

Type: Sub-list of Integer

Optional: No

Possible values: 0 - 65535

Default: None

9.3.2.1.2 Action

Parameter name: Action

Parameter ID: action (0x0002)

Description: This parameter indicates what action the MG should apply to the indicated SCTP StreamIDs.

Type: Enumeration

Optional: No

Possible values:

"accept"	The MG shall accept the outgoing SCTP Stream reset request and apply the procedures from section 5.2.2 of [IETF RFC 6525].
"deny"	The MG shall deny the outgoing SCTP Stream reset request from section 5.2.1 of [IETF RFC 6525].

Default: None

9.4 Statistics

None.

9.5 Error codes

None.

9.6 Procedures

9.6.1 General

If a MG/Termination supports the SCTP Reconfiguration Stream Reset Package, during SCTP Association establishment the support of the RE-CONFIG chunk SCTP protocol extension described should be indicated through the use of the Supported Extensions Parameter defined in [IETF RFC 5061].

The Signals and Events in this package shall be applied to the ITU-T H.248 Stream representing the SCTP Association (i.e., the deaggregation stream, if used). If the outgoing SCTP Stream reset procedures result in the closure of both the incoming and outgoing SCTP Streams from an ITU-T H.248 Stream perspective the MGC may remove the ITU-T H.248 Stream (i.e., the component stream) representing the applicable SCTP StreamID. If the ITU-T H.248 Stream is removed and [ITU-T H.248.96] is used, then the ITU-T H.248 StreamID shall also be removed from the relevant *mgroup/groupse* and *mgroup/strdeagg* properties.

9.6.2 Initiating an outgoing SCTP Stream reset

To request the MG to send an outgoing Stream reset on a particular SCTP Stream(s) the MGC shall send the "Initiate Outgoing SCTP Stream Reset" (*sctpreset/initreset*) Signal with the applicable SCTP StreamIDs in the *sctpid* parameter. On reception of the Signal the MG shall send an outgoing Stream reset request with the applicable StreamIDs according to section 5.1.2 of [IETF RFC 6525].

In order to determine the result of the request, the MGC should also set the "Outgoing SCTP Stream Reset Result" (*sctpreset/result*) Event on the MG. On reception of the reconfiguration response the MG shall perform the procedures from section 5.2.7 of [IETF RFC 6525].

NOTE – The disconnection of an underlying connection oriented layer (DTLS or TCP) or the reception of an SCTP Association shutdown does not require an SCTP Stream reset to be sent.

9.6.3 Responding to an outgoing SCTP Stream reset request

To detect and respond to outgoing SCTP Stream reset requests from the remote peer the MGC shall set the "Detect outgoing SCTP Stream reset" (*sctpreset/detreset*) Event. If the MGC requires that the MG autonomously send reconfiguration responses it shall set the *outresp* parameter to "accept" or "deny". Otherwise, it shall set the *outresp* parameter to "mgc" and the MGC shall indicate via the "Outgoing SCTP Stream reset response" (*sctpreset/resetresp*) with the applicable SCTP StreamIDs. As the reconfiguration response parameter does not contain a list of SCTP StreamIDs but rather a "reconfiguration response sequence number", the MG needs to map this list of SCTP StreamIDs (as received from the MGC) to the "reconfiguration request sequence number", which was contained in the "outgoing SSN reset request" parameter it had previously received (and whose "reconfiguration request sequence number" it has stored).

NOTE – The MG depends on the list of SCTP StreamIDs in the *sctpreset/resetresp* Signal being identical to the list of SCTP StreamIDs, which it had sent to the MGC in the *sctpreset/detreset* Event's "*sctpid*" ObservedEvents Descriptor parameter.

9.6.4 Error handling

[IETF RFC 6525] describes the actions related to SCTP RE-CONFIG chunks that result in errors being generated. The MG is responsible for generating errors related to SCTP level signalling. The "Outgoing SCTP Stream Reset Result" (*sctpreset/result*) Event allows the MG to report errors (e.g., wrong SSN, request already in progress, bad sequence number) to the MGC.

9.6.5 Example information flows

The figures below show example information flows. Figure 10 shows a flow where the MGC is responsible for determining the action to take when an outgoing SCTP Stream reset in received from the remote peer. Figure 11 shows a flow where the MG autonomously responds.

NOTE – In Figure 11, ITU-T H.248 acknowledgement messages are not shown.

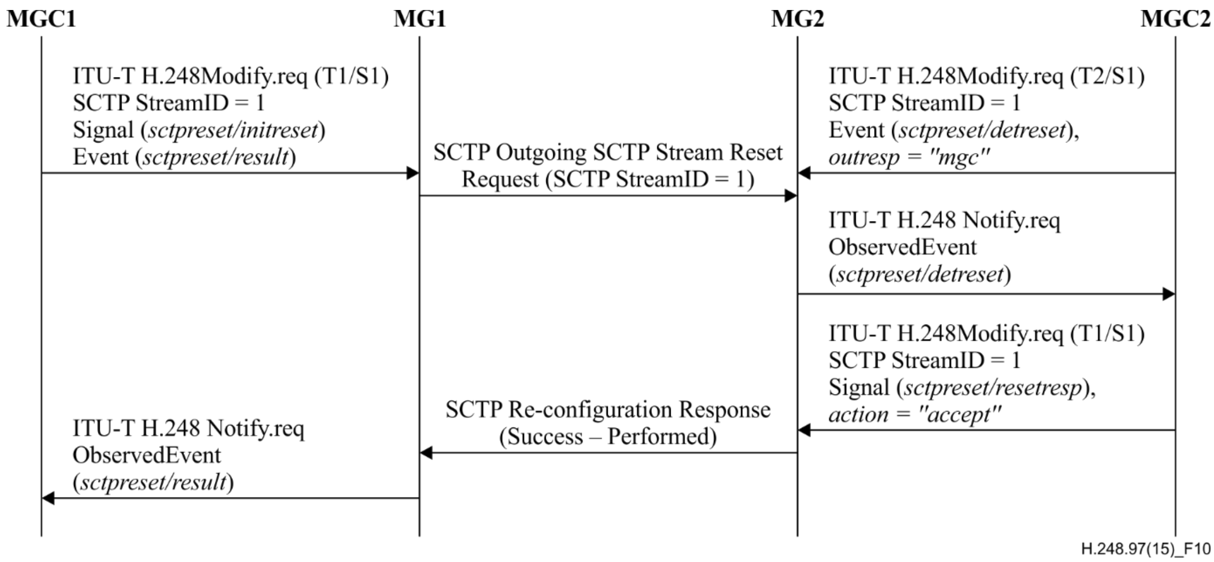

Figure 10 – MGC determined flow

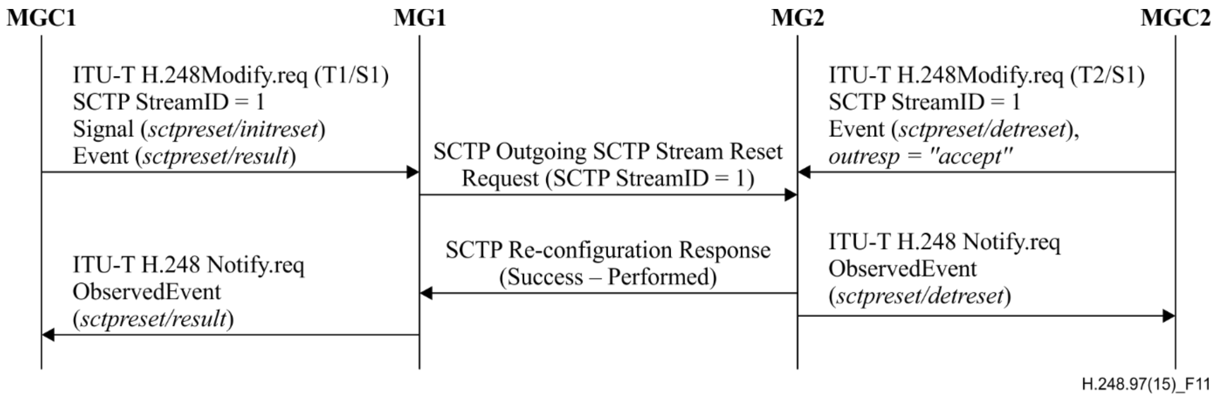

Figure 11 – MG determined flow

10 Package-less SCTP control

For further study.

11 SCTP grouping semantic

11.1 Introduction

[ITU-T H.248.96] introduces so-called ITU-T H.248 Stream grouping which groups together Streams with the same semantic. An aggregation or deaggregation may be defined for an ITU-T H.248 Stream group. The application of ITU-T H.248 Stream grouping is basically relevant for SCTP bearers due to the hierarchical protocol stack structure of some of the ITU-T H.248 SCTP transport modes (see Figure 3 in clause 6.1).

This clause discusses three principle use cases; however, this Recommendation only provides normative grouping semantics for the case when multiple SCTP Streams of an SCTP Association are grouped (clause 11.2).

11.2 Grouping of ITU-T H.248 Streams representing individual SCTP Streams

This Recommendation defines a new "SCTP" grouping semantic to be used in conjunction with Stream deaggregation defined by [ITU-T H.248.96]. The SCTP grouping does not add any semantics to the procedures and handling of the ITU-T H.248 Stream defined in the *sctpbcc* package. Its only purpose is to allow the use of a deaggregation stream (see definition in clause 3.2.5 of [ITU-T H.248.96]. When used with the "Group semantics" (*mgroup/groupse*) property the value "SCTP" indicates that Stream deaggregation shall be applied based on the SCTP Streams in an SCTP Association.

The deaggregation stream represents the SCTP Association as a whole. The Local Descriptor and the Remote Descriptor provide details on the SCTP Association and any information regarding the SCTP Streams.

The SIP session description protocol (SDP) example in Figure 12 shows a deaggregation stream Remote Descriptor supporting SCTP as part of a WebRTC data channel. Two SCTP Streams are supported: one for binary floor control protocol (BFCP) and one for message session relay protocol (MSRP).

The SDP example in Figure 12 is taken from [b-IETF sdpneg].

```
m=application 10001 UDP/DTLS/SCTP webrtc-datachannel
c=IN IP4 10.10.10.1
a=max-message-size:100000
a=sctp-port:5000
a=setup:actpass
a=connection:new
a=fingerprint:SHA-1 \
    4A:AD:B9:B1:3F:82:18:3B:54:02:12:DF:3E:5D:49:6B:19:E5:7C:AB
a=dcmap:0 subprotocol="BFCP";label="BFCP"
a=dcmap:2 subprotocol="MSRP";label="MSRP"
a=dcsa:2 accept-types:message/cpim text/plain
a=dcsa:2 path:msrps://alice.example.com:10001/2s93i93idj;dc
```

Figure 12 – Example SIP SDP from [b-IETF sdpneg]

The component streams represent each of the SCTP Streams in the SCTP Association. The component streams shall be assigned an SCTP StreamID via the "SCTP StreamID" (*sctpbcc/sctpid*) property. This allows the MGC to assign a mapping between the ITU-T H.248 StreamID and the SCTP StreamID. There cannot be two component streams of the same deaggregation stream with the same SCTP StreamID.

The MGC shall also set the "Stream deaggregation property" (*mgroup/strdeagg*) in the deaggregation stream indicating the component ITU-T H.248 StreamIDs related to the applicable SCTP StreamIDs, i.e., the ITU-T H.248 Streams containing the *sctpbcc/sctpid* properties. In the case where multiple SCTP Associations are supported through multiple deaggregation streams a particular component stream must be associated to exactly one deaggregation stream.

NOTE 1 – The [ITU-T H.248.96] Stream grouping model in principle allows the mapping of multiple SCTP Associations to a single ITU-T H.248 Termination; however, it is recommended to use individual Terminations per SCTP Association whenever possible (e.g., due to bearer traffic separation aspects).

Once the [ITU-T H.248.96] *mgroup/groupse*, *mgroup/strdeagg* and *sctpbcc/sctpid* properties are set according to the above, data received at the Termination/deaggregation stream on a particular SCTP StreamID will be forwarded internally to the Context in the MG on the applicable component stream. Data received on the Termination/component stream from internally in the Context in the MG will be forwarded externally via the deaggregation stream.

Table 6 shows an example ITU-T H.248 command setting a deaggregation for the SCTP Association defined in Figure 12.

Table 6 – Example ITU-T H.248 command establishing a deaggregation with an SCTP semantic

<table>
<tr><th>One deaggregation stream and two component streams</th><th>Comments</th></tr>
<tr><td><pre>
MEGACO/3 [123.123.123.4]:55555
Transaction = 10003 {
    Context = 1 {
       Add = T1 {
           Media {
             TerminationState {
                mgroup/groupse= ["SCTP 2 3"]
                             },
             Stream = 1 {
                LocalControl {
                   mgroup/strdeagg=[2,3]
                             },
                Local {
m=application 10001 UDP/DTLS/SCTP webrtc-datachannel
     c=IN IP4 10.10.10.1
     a=max-message-size:100000
     a=sctp-port:5000   ; see NOTE 2
     a=fingerprint:SHA-1 \
 4A:AD:B9:B1:3F:82:18:3B:54:02:12:DF:3E:5D:49:6B:19:E5:7C:AB
     a=dcmap:0 subprotocol="BFCP";label="BFCP"
     a=dcmap:2 subprotocol="MSRP";label="MSRP"
     a=dcsa:2 accept-types:message/cpim text/plain
     a=dcsa:2
path:msrp://alice.example.com:10001/2s93i93idj;dc
                  }
                },
             Stream = 2 {
                LocalControl {
                   sctpbcc/sctpid=0
                             },
                },
             Stream = 3 {
                LocalControl {
                   sctpbcc/sctpid=2
                             },
                }
          }
       }
    }
}
</pre></td><td>This command configures a deaggregation stream with two component streams. One component stream for BFCP and one for MSRP. The "SCTP" semantic is assigned to these Streams.

Neither the "a=setup" nor the "a=connection" attributes are used in ITU-T H.248 signalling.</td></tr>
</table>

NOTE 2 – The MGC provides a fully specified port value for the SCTP Association. The MGC could alternatively use the CHOOSE wildcard in the Local Descriptor. The MG would then assign a local SCTP port value which is equal to its local UDP port.

This SCTP grouping semantic is e.g., applied by ITU-T H.248 WebRTC gateways [ITU-T H.248.94].

11.3 Isolation of DTLS in case of SCTP over DTLS

11.3.1 Single SCTP Association over a DTLS connection

Both SCTP and DTLS represent connection-oriented protocols and a plethora of bearer control procedures. Both protocols themselves provide a hierarchical internal "sublayering" structure (SCTP with levels path, Association and Stream, and DTLS with session and connection level as well as four DTLS sub-protocols). For instance, DTLS: [ITU-T H.248.93] supports quite a number of DTLS control actions besides the pure establishment and release process.

Furthermore, the dynamics at both layers are not necessarily the same, e.g., the direction and point in time of establishment and release could be different. Also, both protocols provide "mid-call" procedures for modifying protocol endpoint configurations and DTLS might even renew the DTLS connection as such.

From this perspective, it might be worth using individual ITU-T H.248 Streams for each protocol. Such an approach would allow the minimization of the amount of signalling information in protocol-individual ITU-T H.248 command request/reply cycles.

The [ITU-T H.248.96] Stream grouping model principally supports the discussed separation model. However, the quantitative benefit is conditional and not given in general. Thus, this Recommendation does not define any correspondent ITU-T H.248 grouping semantics.

11.3.2 Grouping of multiple SCTP Associations over the same DTLS connection

The DTLS encapsulation of SCTP traffic supports multiplexing of multiple SCTP Associations over a single DTLS connection (see clause 6.1 of [b-IETF sctp-dtls-encaps]). The SCTP port element is used for multiplexing and demultiplexing the SCTP Associations. However, this is not currently supported by this Recommendation as there is no mechanism (e.g., via SDP) to indicate its use.

11.4 Separation of DTLS connection and underlying multiple L4 connectivity

Support for interactive connectivity establishment (ICE)-based network address translation (NAT) traversal provides the rationale behind the two SCTP transport modes "*tunnelled SCTP via DTLS over UDP or TCP*". The candidate gathering process for L4 connectivity by ICE introduces an inherent multiplicity of transport connections (TCs) (Figure 13) during the establishment phase, but also during the active call phase which might be driven by ICE actions at TC level due to dynamic NAT issues, media path re-routing, detected security issues, etc.

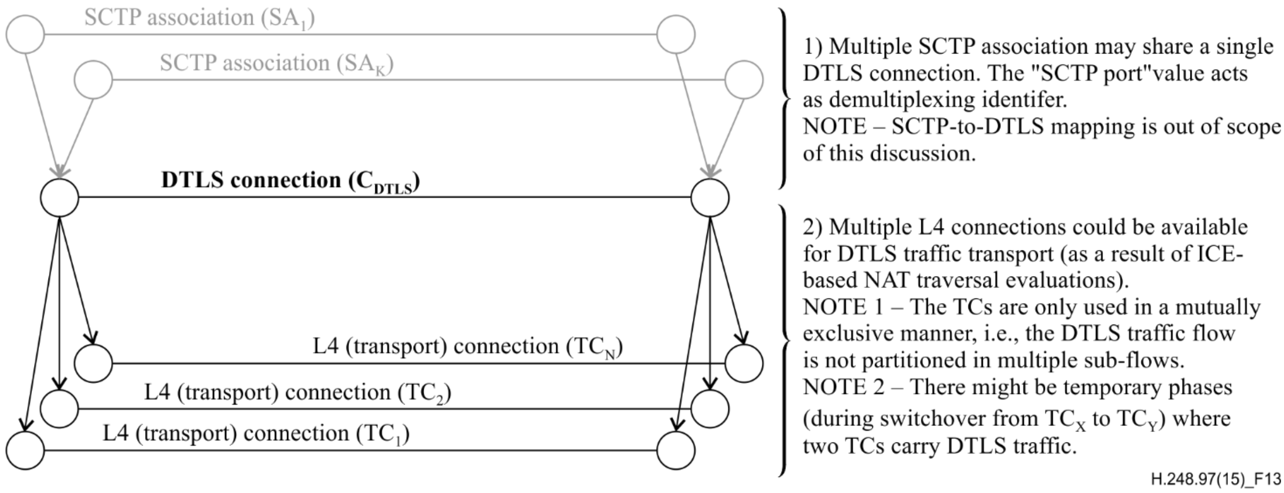

Figure 13 – Connection model for legacy SCTP-over-DTLS in context of ICE-based L4 NAT traversal support

It might be consequently beneficial to use individual ITU-T H.248 Streams for DTLS and the lower layer protocol(s). The primary motivation would be isolation arguments correspondent to clause 11.3.1.

The [ITU-T H.248.96] Stream grouping model principally supports the discussed separation model. However, the quantitative benefit is conditional and not given in general. Thus, this Recommendation does not define any correspondent ITU-T H.248 grouping semantics.

Annex A

State modelling for SCTP bearer connection endpoints

(This annex forms an integral part of this Recommendation.)

A.1 Introduction and purpose

The SCTP *basic connection control* package (clause 8) is tightly coupled to a state model, because the Event (*sctpbcc/BNCChange*) and Signal (*sctpbcc/EstBNC*) are related to state transitioning behaviour. The detailed user plane state model for SCTP is given by Figure 3 of [IETF RFC 4960]. However, a simplified view is sufficient from the perspective of ITU-T H.248 gateway control procedures.

The underlying state model of package *sctpbcc* is described by this Annex.

A.2 Original state model for SCTP bearer connection endpoints

A.2.1 SCTP Association

The principle model for SCTP is comprised of nine states and defined by Figure 3 of [IETF RFC 4960], see Figure A.1.

```
                   -----          -------- (from any state)
                 /       \      /  rcv ABORT      [ABORT]
rcv INIT        |         |    |   ----------  or ----------
--------------- |         v    v   delete TCB     snd ABORT
generate Cookie  \    +---------+                 delete TCB
snd INIT ACK       ---|  CLOSED |
                      +---------+
                       /      \      [ASSOCIATE]
                      /        \     ---------------
                     |          |    create TCB
                     |          |    snd INIT
                     |          |    strt init timer
      rcv valid      |          |
    COOKIE  ECHO     |          v
(1) ---------------- |      +------------+
    create TCB       |      | COOKIE-WAIT| (2)
    snd COOKIE ACK   |      +------------+
                     |          |
                     |          |    rcv INIT ACK
                     |          |    -----------------
                     |          |    snd COOKIE ECHO
                     |          |    stop init timer
                     |          |    strt cookie timer
                     |          v
                     |      +--------------+
                     |      | COOKIE-ECHOED| (3)
                     |      +--------------+
                     |          |
                     |          |    rcv COOKIE ACK
                     |          |    -----------------
                     |          |    stop cookie timer
                     v          v
                   +---------------+
                   |  ESTABLISHED  |
                   +---------------+

                 (from the ESTABLISHED state only)
                               |
```

```
                                     |
                            /--------+--------\
       [SHUTDOWN]          /                   \
       -------------------|                    |
       check outstanding  |                    |
       DATA chunks        |                    |
                          v                    |
                     +---------+               |
                     |SHUTDOWN-|               | rcv SHUTDOWN
                     |PENDING  |               |------------------
                     +---------+               | check outstanding
                          |                    | DATA chunks
     No more outstanding  |                    |
     ---------------------|                    |
     snd SHUTDOWN         |                    |
     strt shutdown timer  |                    |
                          v                    v
                     +---------+        +------------+
                 (4) |SHUTDOWN-|        | SHUTDOWN-  |  (5,6)
                     |SENT     |        | RECEIVED   |
                     +---------+        +------------+
                          |  \                  |
     (A) rcv SHUTDOWN ACK  |   \                  |
     ----------------------|    \                 |
     stop shutdown timer   |     \rcv:SHUTDOWN    |
     send SHUTDOWN COMPLETE|      \  (B)          |
     delete TCB            |       \              |
                           |        \             | No more outstanding
                           |         \            |-----------------
                           |          \           | send SHUTDOWN ACK
     (B)rcv SHUTDOWN       |           \          | strt shutdown timer
     ----------------------|            \         |
     send SHUTDOWN ACK     |             \        |
     start shutdown timer  |              \       |
     move to SHUTDOWN-     |               \      |
     ACK-SENT              |                |     |
                           |                v     |
                           |           +------------+
                           |           | SHUTDOWN-  | (7)
                           |           | ACK-SENT   |
                           |           +-----------+-
                           |                      | (C)rcv SHUTDOWN COMPLETE
                           |                      |-----------------
                           |                      | stop shutdown timer
                           |                      | delete TCB
                           |                      |
                           |                      | (D)rcv SHUTDOWN ACK
                           |                      |--------------
                           |                      | stop shutdown timer
                           |                      | send SHUTDOWN COMPLETE
                           |                      | delete TCB
                           |                      |
                           \    +---------+       /
                            \-->| CLOSED  |<--/
                                +---------+
```

Figure A.1 – SCTP Association state transition diagram
(Figure 3 in [IETF RFC 4960])

Figure A.2 provides an abstraction in order to derive an ITU-T H.248 bearer state model:

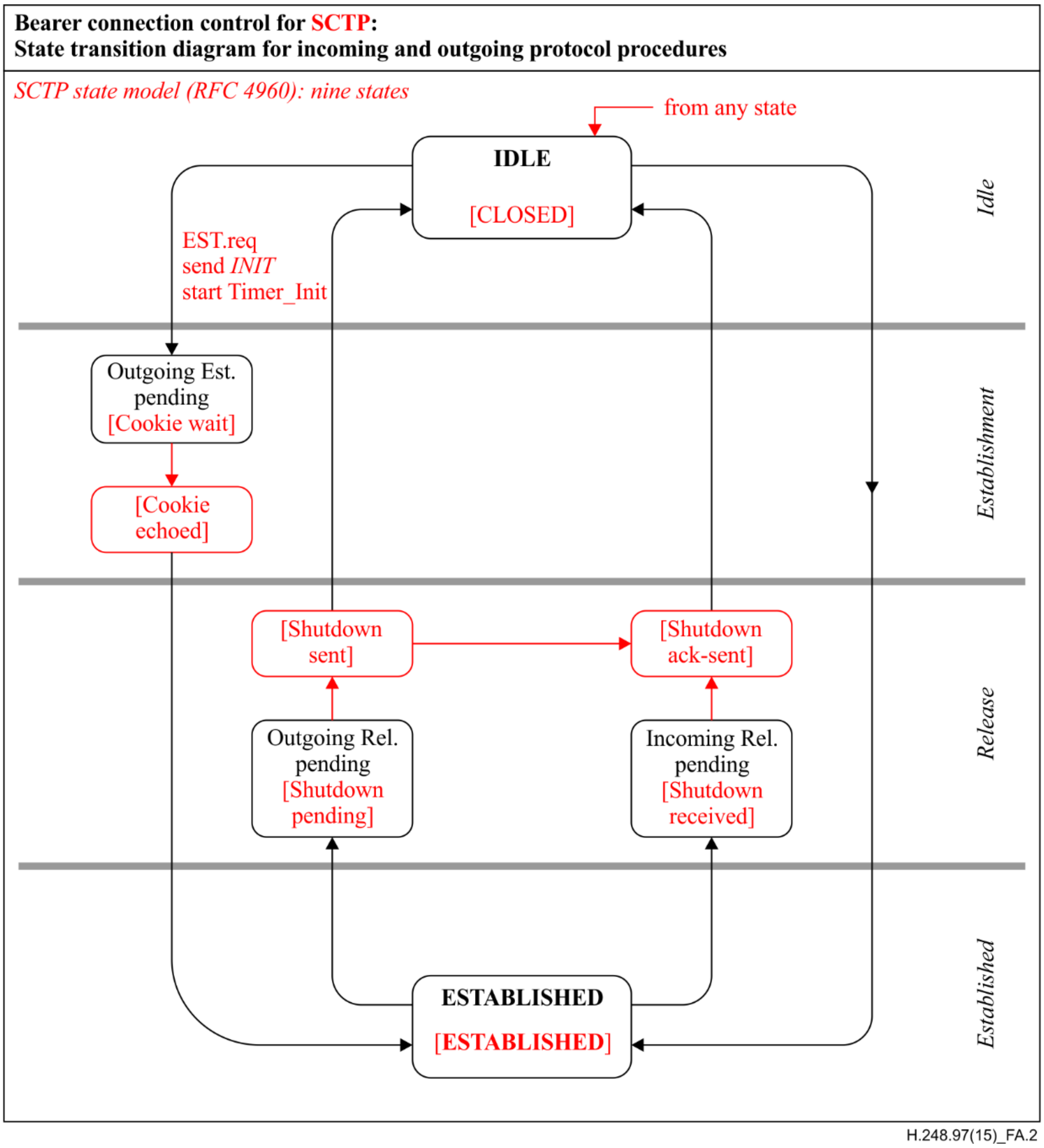

Figure A.2 – SCTP Association state transition diagram (based on Figure 3 in [IETF RFC 4960])

A.2.2 SCTP Stream

The SCTP Stream is stateless. An SCTP Stream either exists or not. It exists if its StreamID is between 0 and the negotiated number of Streams minus 1, regardless of whether a user message has already been sent or not. Thus, there are no bearer control procedures for the establishment of individual Streams. The negotiation and assignment of SCTP Streams is rather subject of e.g., call control signalling or in-band signalling.

A.2.3 Data channel over SCTP Stream

The WebRTC DC [b-IETF webrtc-datachann] in contrast is stateful, with a two-state basic model and the states CLOSED and OPEN. There are bearer control procedures for the transitioning to CLOSED, based on SCTP Association level SCTP Stream reconfiguration signalling.

A.3 Simplified state model for ITU-T H.248-based SCTP basic connection control

The SCTP *basic connection control* package makes a couple of assumptions, primarily:

– bearer establishment: interim states (related to Cookies) are not needed;

– bearer release: interim states (related to shutdown steps) are not needed.

The resulting simplified model is depicted by Figure A.3.

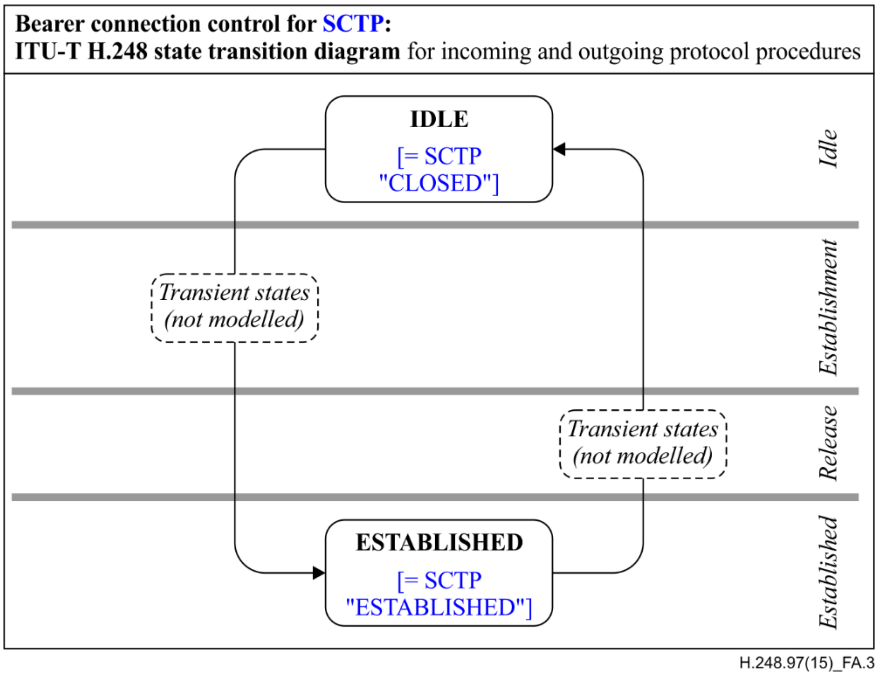

Figure A.3 – Simplified state model for ITU-T H.248-based SCTP basic connection control

There are two remaining states: IDLE and ESTABLISHED in the ITU-T H.248 state model. Signal *sctpbcc/EstBNC* is used for triggering state changes by the MGC, Event *sctpbcc/BNCChange* indicates successfully completed state transitions to the MGC. In more detail, transitioning completed:

– to state ESTABLISHED when SCTP "COOKIE ACK" (as last element of SCTP Association establishment)
  - received for incoming SCTP bearer connection establishment procedure; and
  - sent for outgoing SCTP bearer connection establishment procedure.

– to state IDLE when SCTP "SHUTDOWN COMPLETE" (as last element of SCTP Association shutdown)
  - received for incoming SCTP bearer connection release procedure; and
  - sent for outgoing SCTP bearer connection release procedure.

The MGC may block the establishment of an incoming SCTP bearer connection request, resulting in a third state BLOCKED from an ITU-T H.248 perspective, see Figure A.4.

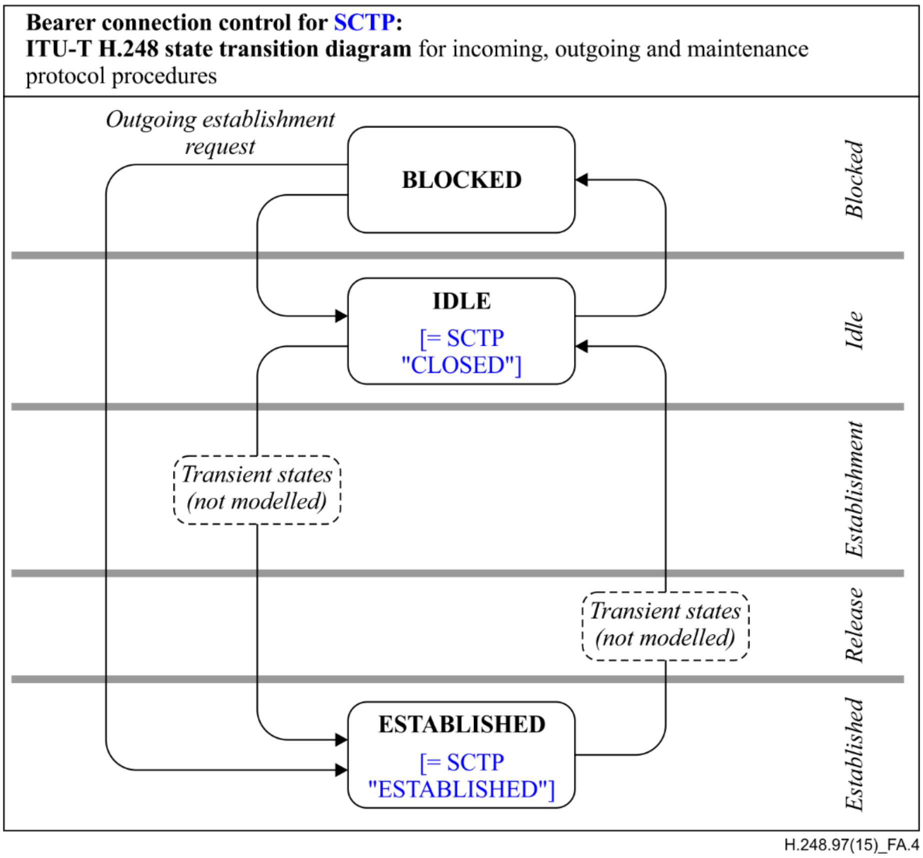

Figure A.4 – Extended state model for ITU-T H.248-based SCTP basic connection control

Regarding the notion of "blocking", the concept of blocking/unblocking of bearer connection procedures is a known concept from BICC (see e.g., [b-ITU-T Q.2630.1]).

A.4 ITU-T H.248 state model for tunnelled SCTP via DTLS/UDP

This transport mode relies on an available DTLS/UDP tunnel prior to the establishment of the SCTP Association. DTLS is a connection oriented layer and the DTLS endpoints have a corresponding state model. However, from the point of view of the SCTP Association, this model can be abstracted in a two state model: "TUNNEL DATA TRANSFER READY" and "TUNNEL NOT DATA TRANSFER READY".

NOTE – [ITU-T H.248.93] may be used for the establishment of the DTLS connection.

Appendix I

SDP for gateway control - IANA considerations

(This appendix does not form an integral part of this Recommendation.)

I.1 Purpose

The ITU-T H.248 gateway control protocol normally reuses the SDP codepoints as defined by the IETF or other organizations. However, gateway control may require additional SDP codepoints. The ones identified by this Recommendation are collected in this clause and are subject to registration with Internet assigned numbers authority (IANA).

I.2 SDP codepoints related to SDP "m=" line <proto> element

This Recommendation identifies the following bearer type indication requirements (Table I.1):

Table I.1 – SDP codepoints related to SDP "m=" line <proto> element

Type	SDP name (value)	Use case	IANA status
`proto`	`"SCTP"`	Application-agnostic bearer type indication	Not yet registered, but already subject of work item [b-IETF sctp-sdp].
`proto`	`"SCTP/DTLS"`	Application-agnostic, transport security protocol specific bearer type indication	
`proto`	`"DTLS/SCTP"`	Application-agnostic, SCTP as tunnel over DTLS	
`proto`	`"SCTP/`*`<application>`*`"`	Application aware bearer type indication	Not yet registered, but subject of application specific IETF RFCs.

There are no additional SDP codepoints that need to be registered with IANA.

I.3 SDP codepoints related to SDP attributes

None.

Appendix II

Example signalling scenarios for tunnelled SCTP via DTLS/UDP and interworking to non-SCTP based data transport

(This appendix does not form an integral part of this Recommendation.)

II.1 Example application for tunnelled SCTP via DTLS/UDP: generic data channel

II.1.1 Network model for interworking to non-SCTP based data transport

Figure II.1 illustrates a "half-call" model with focus on an ITU-T H.248 gateway and peered user equipment (UE). An ITU-T H.248 IP-IP gateway is located between the access and core network level. The DC uses the protocol stack segment SCTP/DTLS/UDP/IP as transport. The data channel is terminated in the ITU-T H.248 MG (see Figure II.1), which implies the termination of protocols 'DTLS' and 'SCTP'.

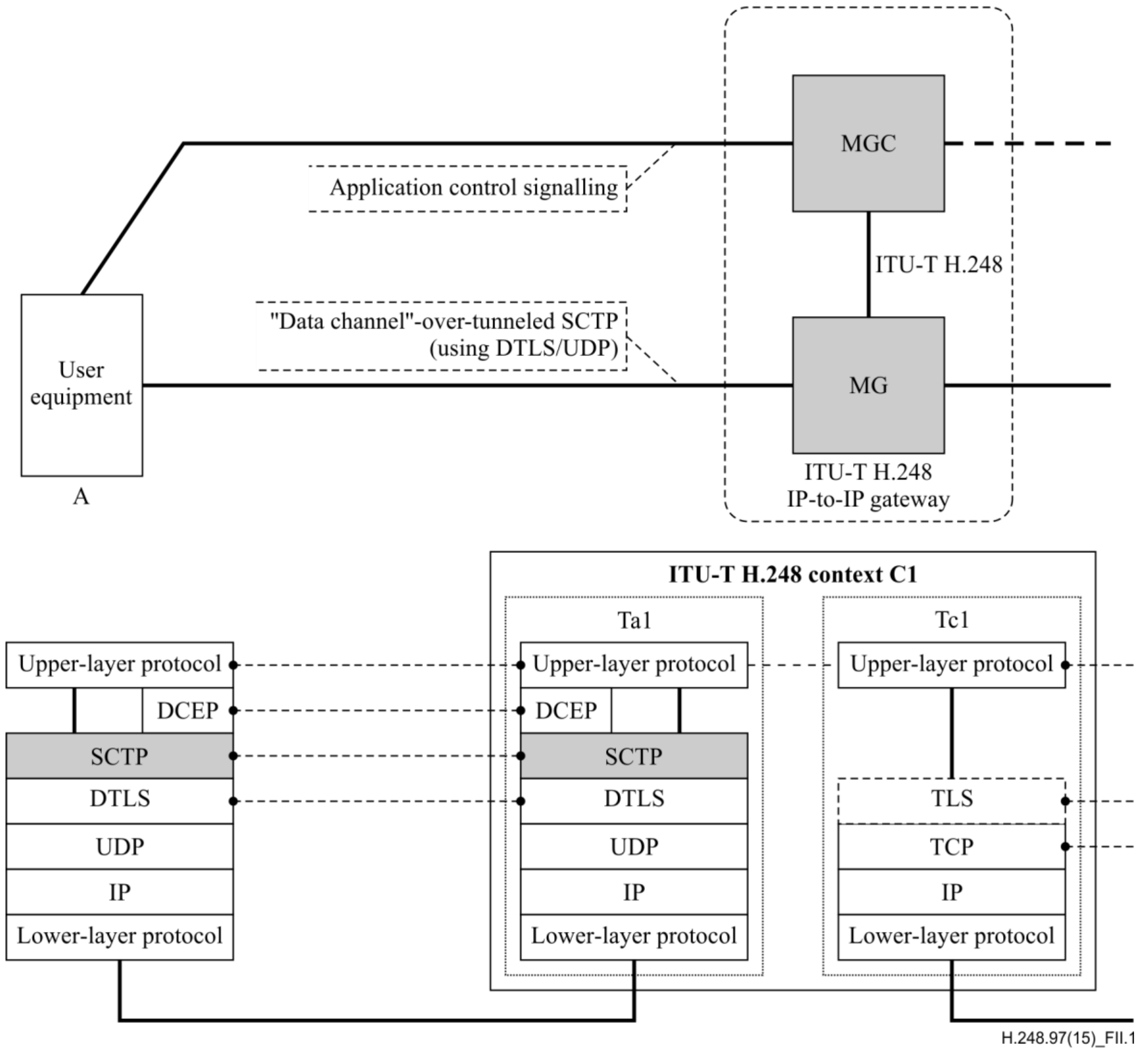

Figure II.1 – Network model for ITU-T H.248 IP access gateways (half-call only) and user plane stacks

Note that this example makes the assumption of successful UDP/IP connectivity between UE_A and the MG, i.e., there is no need to consider 'TCP' as a last resort for DTLS transport.

Both protocols, DTLS and SCTP, are connection-oriented, hence there are correspondent bearer control protocol (BCP) procedures for: first, the establishment of a DTLS session/DTLS connection, and then subsequently, an SCTP Association.

There is only a primary SCTP path used, thus, no secondary SCTP path is prepared due to the fact of the underlying DTLS/UDP tunnel which does not allow SCTP multi-homing.

There will be initial application control signalling (such as SIP-based call control signalling), which triggers the MGC to request DTLS and SCTP bearer connection establishment from the MG (see the following clauses).

II.1.2 Example signalling at SIP and ITU-T H.248 interfaces

A typical SIP-level SDP offer is illustrated in Table II.1.

Table II.1 – Example command encoding – Step (1) – (SIP) SDP offer

(SIP) SDP encoding	Comments

v=0
o=...
s=...
t=...
m=application <UE_A_port_data> UDP/**DTLS/SCTP **
webrtc-datachannel
c=IN IP4 <UE_A_IP_addr_data>
a=max-message-size:100000
a=sctp-port:<UE_A_port_SCTP>
a=dcmap:0 label="chat"
;subprotocol="MSRP"
a=dcsa:0
    accept-types:message/cpim text/plain text/html
a=dcsa:0
    path:msrps://<UE_A_authority>/<UE_A_session>;dc
…
a=fingerprint:SHA-256 <UE_A_DTLS_fingerprint_data>
a=sendrecv…
…
	SIP-level signalling is always application aware (independent of ITU-T H.248 application-agnostic or application aware Context configurations). The application here is indicated as "**MSRP**"-over-"**webrtc-datachannel**", using SCTP transport over a DTLS/UDP tunnel.

The SIP-level SDP offer stimulates an ITU-T H.248 Transaction request from MGC to MG (Table II.2). The media description is application-agnostic (i.e., the MG will not be aware of the IP application protocol 'MSRP', as served user of the data channel).

Table II.2 – Example command encoding – Step (2) – MGC request

ITU-T H.248 encoding (shortened command)	Comments

MGC to MG:
MEGACO/3 [11.9.19.65]:55555
Transaction = 1 {
  Context = $ {
    Add = ip/$/$/$ {
      Media {
        TerminationState {
          mgroup/groupse = ["SCTP 2"],
        },
        Stream = 1 {
          LocalControl {
            mgroup/strdeagg=[2],
            ipdc/realm = <access realm>,
            Mode = Inactive,
            ...
          },
	An ITU-T H.248 Stream group is created due to the fact of possible later added WebRTC data channels. The Add command requests a Stream group, which consists of the first component stream (2). A deaggregation stream (1) is defined for the group. The StreamMode of the deaggregation stream is initially set to 'Inactive'. The deaggregation stream contains the protocol stack segment SCTP Association over DTLS/UDP/IP.

Table II.2 – Example command encoding – Step (2) – MGC request

ITU-T H.248 encoding (shortened command)	Comments

`          Local {`
`            v=0`
`            c=IN IP6 $`
`            m=application $ UDP/DTLS/SCTP \`
`                webrtc-datachannel`
`            a=max-message-size:…`
`            a=sctp-port:$`
`                      …`
`          },`
`          Remote {`
`            v=0`
`            c=IN IP6 <UE_A_IP_addr_data>`
`            m=application <UE_A_port_data> \`
`                UDP/DTLS/SCTP`
`                webrtc-datachannel`
`            a=max-message-size:…`
`            a=sctp-port:<UE_A_port_SCTP>`
`           }`
`        },`
`        Stream = 2 {`
`          LocalControl {`
`              Sctpbcc/sctpid = 0`
`          }`
`        }`
`…`
`}`
	The SCTP port is wildcarded 'CHOOSE' in the Local Descriptor of the deaggregation stream as the MG is requested to assign a local SCTP port, which is equal to its local UDP port (in case of a single SCTP Association only).
	The example command does not contain ITU-T H.248 signalling elements related to the establishment of the DTLS connection and SCTP Association, and also omits ICE-related signalling elements.

A possible example MG reply is indicated in Table II.3.

Table II.3 – Example command encoding – Step (3) – MG reply

ITU-T H.248 encoding (shortened command)	Comments

`MG to MGC:`
`MEGACO/3 [11.9.19.27]:4646`
`Transaction = 1 {`
`  Context = 101 {`
`    Add = ip/1/2/3 {`
`      Media {`
`        Stream = 1 {`
`          Local {`
`            v=0`
`            c=IN IP6 <MG_A_IP_addr_data>`
`            m=application <MG_A_port_data> \`
`                 UDP/DTLS/SCTP webrtc-datachannel`
`            a= max-message-size:…`
`            a=sctp-port:<MG_A_port_data>`
`          },`
`          Remote {`
`            v=0`
`            c=IN IP6 <UE_A_IP_addr_data>`
`            m=application <UE_A_port_data> \`
`                UDP/DTLS/SCTP webrtc-datachannel`
`            a=max-message-size:…`
`            a=sctp-port:<UE_A_port_SCTP>`
`          }`
	The MG confirms the request for an application-agnostic WebRTC data channel.
	The Transaction reply contains both Streams, the deaggregation stream (1) and an explicit acknowledgement of the creation of component stream (2).

Table II.3 – Example command encoding – Step (3) – MG reply

ITU-T H.248 encoding (shortened command)	Comments

`Stream = 2 {`
`  Local {},`
`  Remote {}`
`}`
`…`
`}`	

The application-agnostic WebRTC data channel "SCTP Stream/SCTP Association/DTLS/UDP/IP" might be mapped on an application-agnostic TCP bearer connection. The MG then provides an IWF between SCTP messages and TCP segments. This is a feasible IWF, but conditional, e.g., dependent on further default parameter values of the SCTP layer ("parameters which were not signalled in-band or/and out-of-band"), single SCTP Stream usage ("SCTP Stream 0 mapped to TCP", therefore property " *sctpbcc/sctpid*=0" is required at the ITU-T H.248 interface) and the actual IP application protocol (e.g., not possible for MRSP, but feasible for legacy IP data applications).

II.2 Example application for tunnelled SCTP via DTLS/UDP: application-aware data channel service for WebRTC

II.2.1 Network model for interworking to non-SCTP based data transport and example application MSRP

Figure II.1 summarizes the half-call model and bearer plane protocol stacks. The MG is now aware of the IP application protocol 'MSRP'. The data channel is terminated by the MG and the application data then uses native, TCP-based transport as defined for MSRP. There might be an optional 'TLS' based transport security on top of TCP.

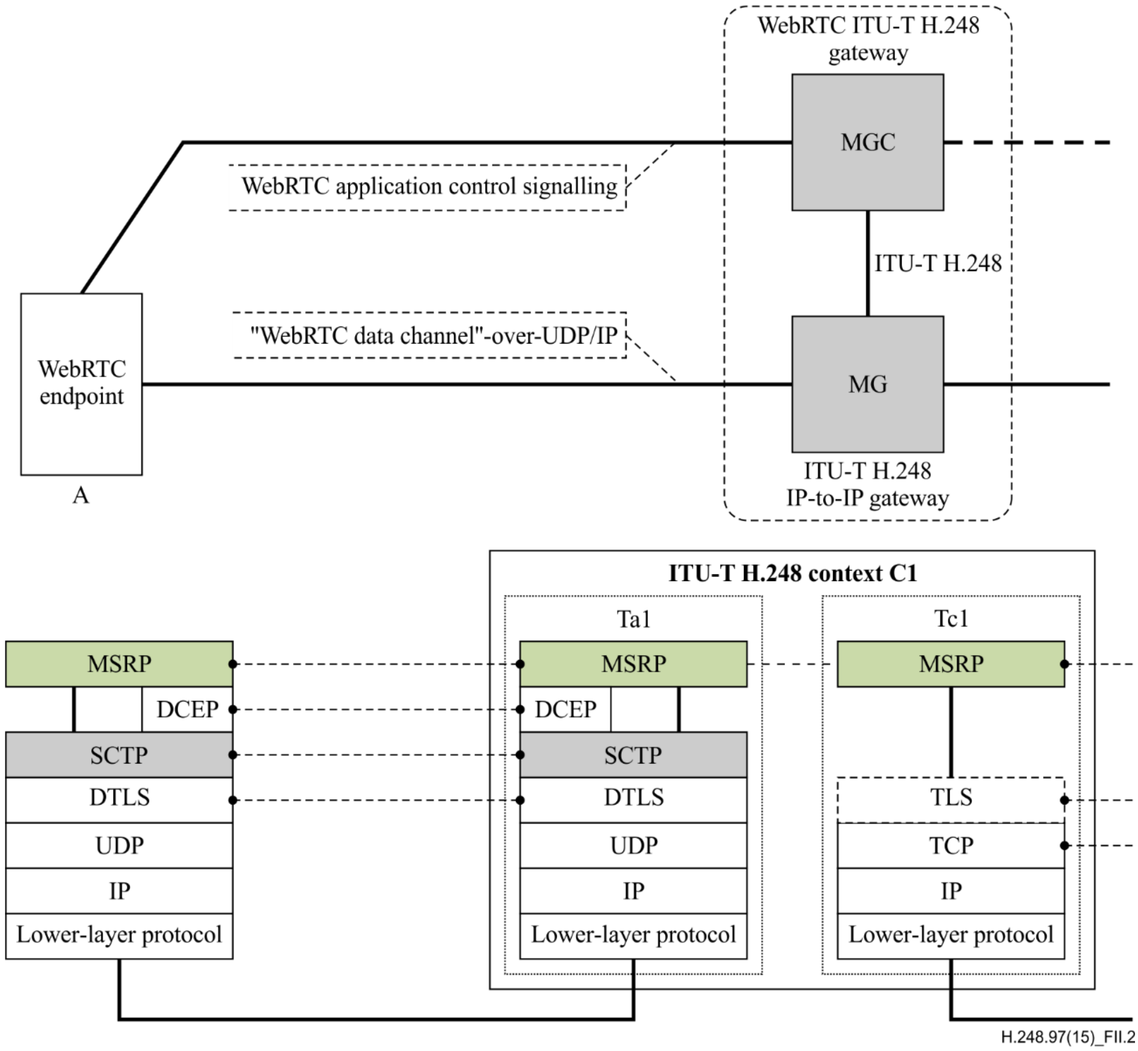

Figure II.2 – Network model for ITU-T H.248 IP access gateways (half-call only) and user plane stacks – application-aware data channel service for WebRTC for application 'MSRP'

The interworking between MSRP/DC/SCTP/DTLS/UDP and MSRP/(TLS/)TCP implies a fragmentation and reassembly service due to the complete protocol termination of the lower layer protocols below MSRP.

II.2.2 Example signalling at SIP and ITU-T H.248 interfaces

II.2.2.1 Communication stacks overview and control plane building blocks

The scope of this Recommendation is on SCTP, hence the WebRTC data channel part of an overall WebRTC multimedia communication service (see [ITU-T H.248.94]). Figure II.3 outlines the overall layered protocol architecture and provides references to the relevant IETF technologies.

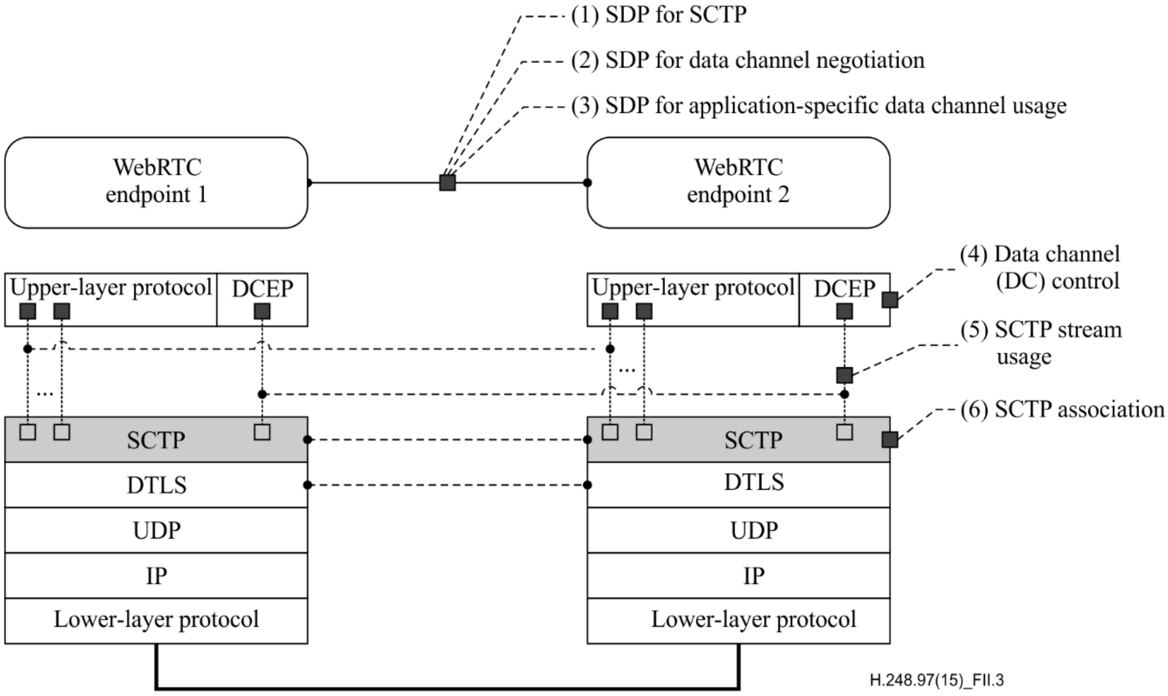

Figure II.3 – WebRTC data channel end-to-end communication stacks in general (and for WebRTC for application 'MSRP' in particular)

Explanations to Figure II.3:

(1) [b-IETF sctp-sdp] describes how to negotiate SCTP-over-DTLS transport.

Example SDP offer (offering 16 data channel instances):

```
m=application 54111 UDP/DTLS/SCTP webrtc-datachannel
c=IN IP4 79.97.215.79
a=sctp-port:5000
a=max-message-size:100000
```

(2) [b-IETF sdpneg] specifies how to use SDP offer/answer procedures for external negotiation of data channels, sub-protocols and sub-protocol specific attributes. It introduces the related "a=dcmap" and "a=dcsa" SDP attributes.

(3) [b-IETF data-channel-msrp] specifies how to negotiate data channels for MSRP usage based on the data channel and sub-protocol external SDP negotiation introduced in [b-IETF sdpneg].

(4) **DC control**

[b-IETF webrtc-datachann] describes two basic alternatives on how to add and close data channel instances. These two alternatives are:

– **in-band open**: this is specified in [b-IETF rtcweb-data-protocol]. This alternative is based on the DATA_CHANNEL_OPEN and DATA_CHANNEL_ACK messages to open a channel on an unused SCTP Stream;

– **external negotiation**: applications use a signalling channel (which may also be a dedicated data channel instance) to declare/negotiate data channel instantiation, intended sub-protocol and sub-protocol related attributes; the DATA_CHANNEL_OPEN message is not used. It does not define the external negotiation protocol.

(5) **SCTP Stream usage**

one WebRTC data channel instance maps to one pair of unidirectional (incoming and outgoing) SCTP Streams;

the number of SCTP Streams may initially be negotiated out-of-band ("external negotiation") but may also be extended via in-band request (based on SCTP Association reconfiguration procedure).

(6) **SCTP Association**

[b-IETF sctp-dtls-encaps] describes "DTLS Encapsulation of SCTP Packets";

Single-homed SCTP Association endpoints.

The WebRTC data channel handling from the perspective of an ITU-T H.248 gateway is outlined in Figure II.4.

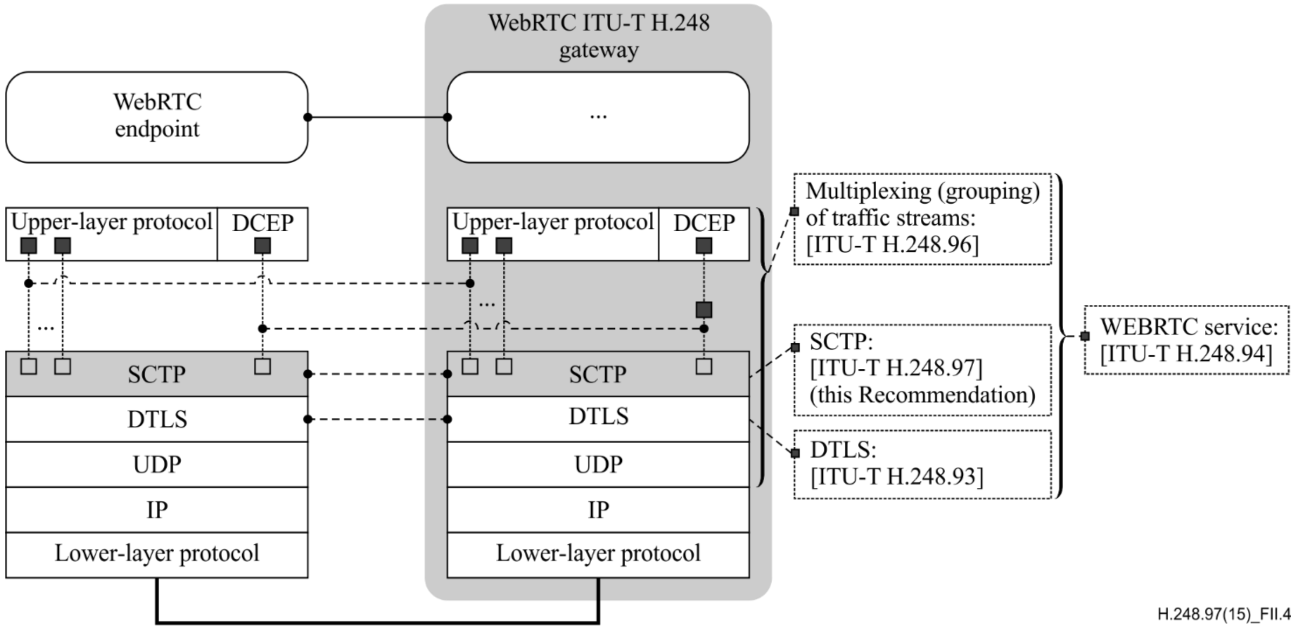

Figure II.4 – Relevant ITU-T H.248.x-series Recommendations in case of a WebRTC ITU-T H.248 gateway

II.2.2.2 "WebRTC call" originating at user equipment

Note that all SDP and ITU-T H.248 signalling structures are incomplete, only relevant information is indicated in this example.

The following message sequence diagram (Figure II.5) shows the messages and message numbering scheme used by all message flows in this example, which are related to UE A being the communication session originator.

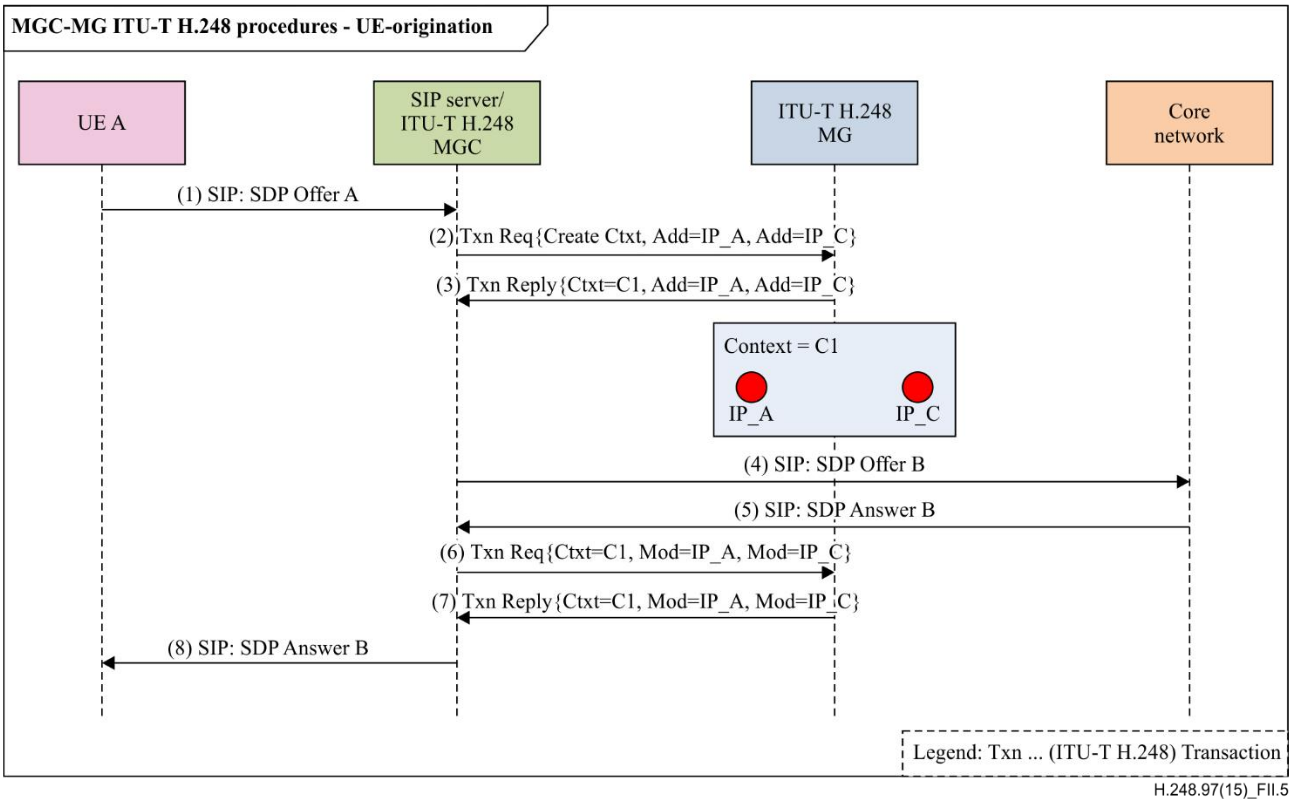

Figure II.5 – MGC-MG ITU-T H.248 procedures – UE origination

The UE-embedded WebRTC client originates a MSRP session across a WebRTC data channel (Table II.4).

Table II.4 – Example command encoding – Step (1) – (SIP) SDP offer

(SIP) SDP encoding	Comments
v=0 o=... s=... t=... **m=application** <UE_A_port_data> UDP/**DTLS/SCTP** \ **webrtc-datachannel** c=IN IP4 <UE_A_IP_addr_data> **a=sctp-port:<UE_A_port_SCTP>** **a=max-message-size:...** **a=dcmap:0 ** **label="<UE_A_label>"; subprotocol="MSRP"** **a=dcsa:0 ** **accept-types:message/cpim text/plain text/html** **a=dcsa:0 ** **path:msrps://<UE_A_authority>/<UE_A_session>;dc** … a=setup:actpass a=connection:new a=fingerprint:SHA-256 <UE_A_DTLS_fingerprint_data> a=sendrecv… …	The basic WebRTC data channel is requested based on SDP elements from: • [b-IETF sctp-sdp]; and • [b-IETF sdpneg]. The usage of this WebRTC data channel for the IP application protocol "MSRP" is achieved by profiling of the two SDP attributes "a=dcmap" and "a=dcsa" according to • [b-IETF data-channel-msrp]. The SDP lines "a=setup:" and "a=connection:" in [b-IETF sdpneg] are part of the SIP-level SDP offer; the semantic is related to the DTLS layer only, but not SCTP.

The MGC prepares the MG by creating an ITU-T H.248 Stream group at the ITU-T H.248 WebRTC Termination and a TCP-enabled ITU-T H.248 Stream at the ITU-T H.248 non-WebRTC Termination, see Table II.5.

Table II.5 – Example command encoding – Step (2) – MGC request

ITU-T H.248 encoding (shortened command)

```
MGC to MG:
MEGACO/3 [11.9.19.65]:55555
Transaction = 1 {
  Context = $ {
    Add = ip/$/$/$ {
      Media {
        TerminationState {
         mgroup/groupse = ["SCTP 2"]
        },         Stream = 1 {
          LocalControl {
            mgroup/strdeagg=[2],
            ipdc/realm = <access realm>,
            Mode = Inactive,
            ...
          },
          Local {
            v=0
            c=IN IP6 $
            m=application $ UDP/DTLS/SCTP \
                webrtc-datachannel
            a=sctp-port:$
            a=max-message-size:…
            a=fingerprint:$ $
          },
          Remote {
            v=0
            c=IN IP6 <UE_A_IP_addr_audio_rtp>
            m=application <UE_A_port_data> \
                UDP/DTLS/SCTP webrtc-datachannel
            a=sctp-port:<UE_A_port_SCTP>
            a=max-message-size:…
            a=fingerprint:SHA-256 \
                <UE_A_DTLS_fingerprint_data>
          }
        },
        Stream = 2 {
          LocalControl {
           sctpbcc/sctpid=0
          },
          Local {
            v=0
            c=- - -
            m=application - - webrtc-datachannel
            a=dcmap:0 subprotocol="MSRP"
            a=dcsa:0 a=setup:passive
          },
          Remote {
            v=0
            c=- - -
            m=application - - webrtc-datachannel
            a=dcmap:0 subprotocol="MSRP"
            a=dcsa:0 path:msrps://<UE_A_authority>/\
                <UE_A_session>;dc
          }
        }
```

Comments

An ITU-T H.248 Stream group is created due to the fact of possible later added WebRTC data channels. The Add command requests a Stream group, which consists of the first component stream (2). A deaggregation stream (1) is defined for the group. The StreamMode of the deaggregation stream is initially set to 'Inactive'. The deaggregation stream contains the protocol stack segment SCTP Association over DTLS/UDP/IP.

The SCTP port it not signalled in the Local Descriptor of the deaggregation stream (1) as the MG is requested to assign a local SCTP port, which is equal to its local UDP port.

The component stream (2)'s Local and Remote Descriptors are layer 4 transport protocol port number and protocol stack agnostic as the related information is taken care of by the deaggregation stream.

The partner stream endpoint of the WebRTC side's component stream endpoint is requested to support MSRP over TCP. It is additionally requested to assume the TCP client role and hence to establish the TCP transport connection. The TCP connection establishment is controlled via [ITU-T H.248.89], which is not shown in this example.

Table II.5 – Example command encoding – Step (2) – MGC request

<table>
<tr><th>ITU-T H.248 encoding (shortened command)</th><th>Comments</th></tr>
<tr><td><pre>
      }
    },
…
    Add = ip/$/$/$ {
      Media {
        Stream = 2 {
          LocalControl {
            ipdc/realm = <core realm>,
            Mode = SendReceive,
            ...
          },
          Local {
            v=0
            c=IN IP4 $
            m=message $ TCP/MSRP -
          }
        }
      }
    }
}}}
</pre></td><td></td></tr>
</table>

A possible example MG reply is indicated in Table II.6.

Table II.6 – Example command encoding – Step (3) – MG reply

<table>
<tr><th>ITU-T H.248 encoding (shortened command)</th><th>Comments</th></tr>
<tr><td><pre>
MG to MGC:
MEGACO/3 [125.125.125.111]:55555
Reply = 1 {
  Context = <C1> {
    Add = <IP_A> {
      Media {
        Stream = 1 {

          Local {
            v=0
            c=IN IP6 <UE_A_IP_addr_data>
            m=application <MG_A_port_data> \
                UDP/DTLS/SCTP webrtc-datachannel
            a=sctp-port:<MG_A_port_data>
            a=max-message-size:…
            a=fingerprint: SHA-256 \
                <MG_A_DTLS_ fingerprint_data >
            a=setup:passive
          },
          Remote {
            v=0
            c=IN IP6 <UE_A_IP_addr_audio_rtp>
            m=application <UE_A_port_data> \
                UDP/DTLS/SCTP webrtc-datachannel
            a=sctp-port:<UE_A_port_SCTP>
            a=max-message-size:…
            a=fingerprint:SHA-256 \
                <UE_A_DTLS_fingerprint_data>
          }

        },
</pre></td><td>The MG confirms the creation of the ITU-T H.248 Stream group at the WebRTC network side and the TCP-enabled stream endpoint at non-WebRTC network side, inclusive the application-aware settings.</td></tr>
</table>

Table II.6 – Example command encoding – Step (3) – MG reply

<table>
<tr><th>ITU-T H.248 encoding (shortened command)</th><th>Comments</th></tr>
<tr><td><pre>
        Stream = 2 {
          Local {
            v=0
            c=- - -
            m=application - - webrtc-datachannel
            a=dcmap:0 subprotocol="MSRP"
            a=dcsa:0 a=setup:passive
          },
          Remote {
            v=0
            c=- - -
            m=application - - webrtc-datachannel
            a=dcmap:0 subprotocol="MSRP"
            a=dcsa:0 path:msrps://<UE_A_authority>/\
                <UE_A_session>;dc
          }
        }
      }
    },
    Add = <IP_C> {
      Media {
        Stream = 1 {
          Local {
            v=0
            c=IN IP4 <IP_C_IP_addr_data>
            m=message <IP_C_port_data> TCP/MSRP –
           }
        }
      }
    }
}}
}
</pre></td><td></td></tr>
</table>

The remaining signalling steps (4) to (8) do not add substantially new information and are therefore omitted.

II.2.2.3 "WebRTC call" terminating at user equipment

The following message sequence diagram (Figure II.6) shows example message for UE A terminating the communication session.

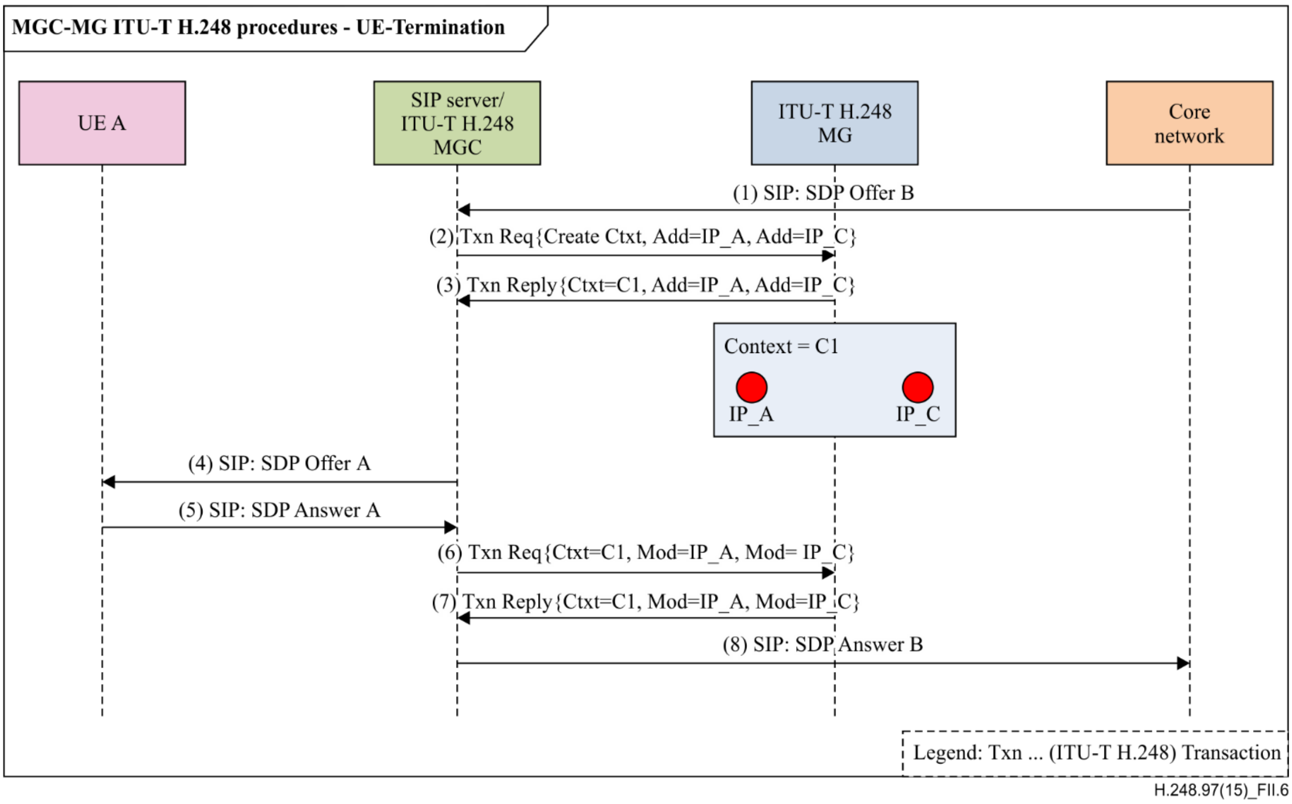

Figure II.6 – MGC-MG ITU-T H.248 procedures – UE Termination

II.3 Example application for tunnelled SCTP via DTLS/UDP: application-aware data channel service for telepresence

For further study.

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