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SERIES Q: SWITCHING AND SIGNALLING

Broadband ISDN – Signalling ATM adaptation layer (SAAL)

Signalling transport converter on SCTP

ITU-T Recommendation Q.2150.3

ITU-T Q-SERIES RECOMMENDATIONS

SWITCHING AND SIGNALLING

SIGNALLING IN THE INTERNATIONAL MANUAL SERVICE	Q.1–Q.3
INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC WORKING	Q.4–Q.59
FUNCTIONS AND INFORMATION FLOWS FOR SERVICES IN THE ISDN	Q.60–Q.99
CLAUSES APPLICABLE TO ITU-T STANDARD SYSTEMS	Q.100–Q.119
SPECIFICATIONS OF SIGNALLING SYSTEM No. 4	Q.120–Q.139
SPECIFICATIONS OF SIGNALLING SYSTEM No. 5	Q.140–Q.199
SPECIFICATIONS OF SIGNALLING SYSTEM No. 6	Q.250–Q.309
SPECIFICATIONS OF SIGNALLING SYSTEM R1	Q.310–Q.399
SPECIFICATIONS OF SIGNALLING SYSTEM R2	Q.400–Q.499
DIGITAL EXCHANGES	Q.500–Q.599
INTERWORKING OF SIGNALLING SYSTEMS	Q.600–Q.699
SPECIFICATIONS OF SIGNALLING SYSTEM No. 7	Q.700–Q.799
Q3 INTERFACE	Q.800–Q.849
DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 1	Q.850–Q.999
PUBLIC LAND MOBILE NETWORK	Q.1000–Q.1099
INTERWORKING WITH SATELLITE MOBILE SYSTEMS	Q.1100–Q.1199
INTELLIGENT NETWORK	Q.1200–Q.1699
SIGNALLING REQUIREMENTS AND PROTOCOLS FOR IMT-2000	Q.1700–Q.1799
SPECIFICATIONS OF SIGNALLING RELATED TO BEARER INDEPENDENT CALL CONTROL (BICC)	Q.1900–Q.1999
BROADBAND ISDN	Q.2000–Q.2999
General aspects	Q.2000–Q.2099
Signalling ATM adaptation layer (SAAL)	**Q.2100–Q.2199**
Signalling network protocols	Q.2200–Q.2299
Common aspects of B-ISDN application protocols for access signalling and network signalling and interworking	Q.2600–Q.2699
B-ISDN application protocols for the network signalling	Q.2700–Q.2899
B-ISDN application protocols for access signalling	Q.2900–Q.2999

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ITU-T Recommendation Q.2150.3

Signalling transport converter on SCTP

Summary

This Recommendation specifies the Signalling Transport Converter on the Stream Control Transmission Protocol (SCTP). This Signalling Transport Converter on SCTP utilizes the services offered by the SCTP. The sublayer structure, the PDU structures of the signalling transport converter sublayer, and the mechanisms for the provision of the generic signalling transport service are defined in depth.

The intent of this Recommendation is to provide a protocol specification that can be used in an IP environment for the provision of a signalling transport service. In particular, this protocol provides a Generic Signalling Transport Service that is used by AAL type 2 and Bearer Independent Call Control (BICC) signalling protocols

Source

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Keywords

(AAL) ATM Adaptation Layer, (BICC) Bearer Independent Call Control, (IP) Internet Protocol, (SCTP) Stream Control Transmission Protocol, (STC) Signalling Transport Converter.

FOREWORD

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CONTENTS

		Page
1	Scope	1
2	References	1
	2.1 Normative references	1
	2.2 Bibliography	1
3	Definitions	2
4	Abbreviations	2
5	General description of the signalling transport converter on SCTP	2
	5.1 Structure of the signalling transport converter on SCTP sublayer	2
	5.2 Services provided by the STC	3
	5.3 Functions of the STC	4
6	Elements for layer-to-layer communication	4
	6.1 The generic signalling transport service	4
	6.2 The Service provided by SCTP	5
	6.3 Primitives between the STC and layer management	9
7	Protocol elements for peer-to-peer communication	10
	7.1 STC messages (STC-PDUs)	10
	7.2 STC state variable	11
	7.3 STC timers	11
	7.4 Provisioned STC parameters	11
8	Specification of the STC	12
	8.1 Overview	12
	8.2 Procedures of the STC	13
	8.3 State transition table	15
Appendix I – Protocol Implementation Conformance Statement (PICS) Proforma		15

ITU-T Recommendation Q.2150.3

Signalling transport converter on SCTP

1 Scope

This Recommendation specifies the signalling transport converter sublayer on top of the Stream Control Transmission Protocol (SCTP) specified in IETF RFC 2960 [2] and RFC 3309 [5] which specifies a reliable transport protocol operating over a connectionless packet network such as IP. This Recommendation covers the specification of the sublayer structure, the PDU structures of the signalling transport converter sublayer, and the procedures for the provision of the signalling transport service.

When this Signalling Transport Converter on SCTP is applied for a signalling protocol entity, that entity is liberated from considering the peculiarities of the underlying signalling transport service. This is achieved by relying on a generic signalling transport service that is provided, for example, by the sublayer specified in this Recommendation.

This Recommendation describes the interactions between the Signalling Transport Converter (STC) and the next higher layer, e.g., the AAL type 2 [6], [8] or BICC [7] signalling protocol entity, between the STC and the SCTP, and between the STC and layer management.

2 References

2.1 Normative 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.

[1] ITU-T Recommendation Q.2150.0 (2001), *Generic signalling transport service*.

[2] IETF RFC 2960 (2000), *Stream Control Transmission Protocol*.

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

[4] ITU-T Recommendation X.210 (1993), *Information technology – Open Systems Interconnection – Basic Reference Model: Conventions for the definition of OSI services*.

[5] IETF RFC 3309 (2002), *Stream Control Transmission Protocol (SCTP) Checksum Change*.

2.2 Bibliography

The following ITU-T Recommendations and other documents contain information that may be useful to understanding the usage of this Recommendation. There are no additional provisions of this Recommendation derived from these documents that are not already contained in the text of this Recommendation.

[6] ITU-T Recommendation Q.2630.1 (1999), *AAL type 2 signalling protocol – Capability Set 1*.

[7] ITU-T Recommendation Q.1902.1 (2001), *Bearer Independent Call Control Protocol (Capability Set 2): Functional description*.

[8] ITU-T Recommendation Q.2630.2 (2000), *AAL type 2 signalling protocol – Capability Set 2*.

[9] IETF RFC 791 (1981), *Internet Protocol (IPv4)*.

[10] IETF RFC 2460 (1998), *Internet Protocol (IPv6)*.

[11] ITU-T Recommendation Q.2110 (1994), *B-ISDN ATM adaptation layer – Service specific connection oriented protocol (SSCOP)*.

[12] ITU-T Recommendation Q.701 (1993), *Functional description of the message transfer part (MTP) of Signalling System No.7*.

[13] ITU-T Recommendation Q.2210 (1996), *Message transfer part level 3 functions and messages using the services of ITU-T Recommendation Q.2140*.

3 Definitions

This Recommendation is based upon the concepts developed in ITU-T Recs X.200 [3] and X.210 [4] as well as definitions specified in clause 1.4 of IETF RFC 2960 [2].

4 Abbreviations

This Recommendation uses the following abbreviations:

BICC	Bearer Independent Call Control
CIC	Call Instance Code
IANA	Internet Assigned Numbers Authority
IETF	Internet Engineering Task Force
IP	Internet Protocol
MTP3	Message Transfer Part level 3 (Narrowband)
MTP3b	Message Transfer Part level 3 (Broadband)
MTU	Maximum Transmission Unit
PDU	Protocol Data Unit
SCTP	Stream Control Transmission Protocol
SSCOP	Service Specific Connection Oriented Protocol
STC	Signalling Transport Converter

For SCTP specific abbreviations, refer to clause 1.5 of IETF RFC 2960 [2].

5 General description of the signalling transport converter on SCTP

5.1 Structure of the signalling transport converter on SCTP sublayer

The sublayer providing the Signalling Transport Converter (STC) resides on top of the Stream Control Transmission Protocol (SCTP). It employs the services provided by the SCTP defined in IETF RFC 2960 [2] and RFC 3309 [5].

The STC provides the service that is requested by the Generic Signalling Transport Service defined in ITU-T Rec. Q.2150.0 [1], where the signalling protocol makes use of this service. The complete protocol stack is illustrated in Figure 5-1.

This Recommendation specifies:

- the interactions between the STC and the STC and the signalling protocol entity;
- the interactions between the STC and the SCTP layer; and
- the interactions between the STC and layer management.

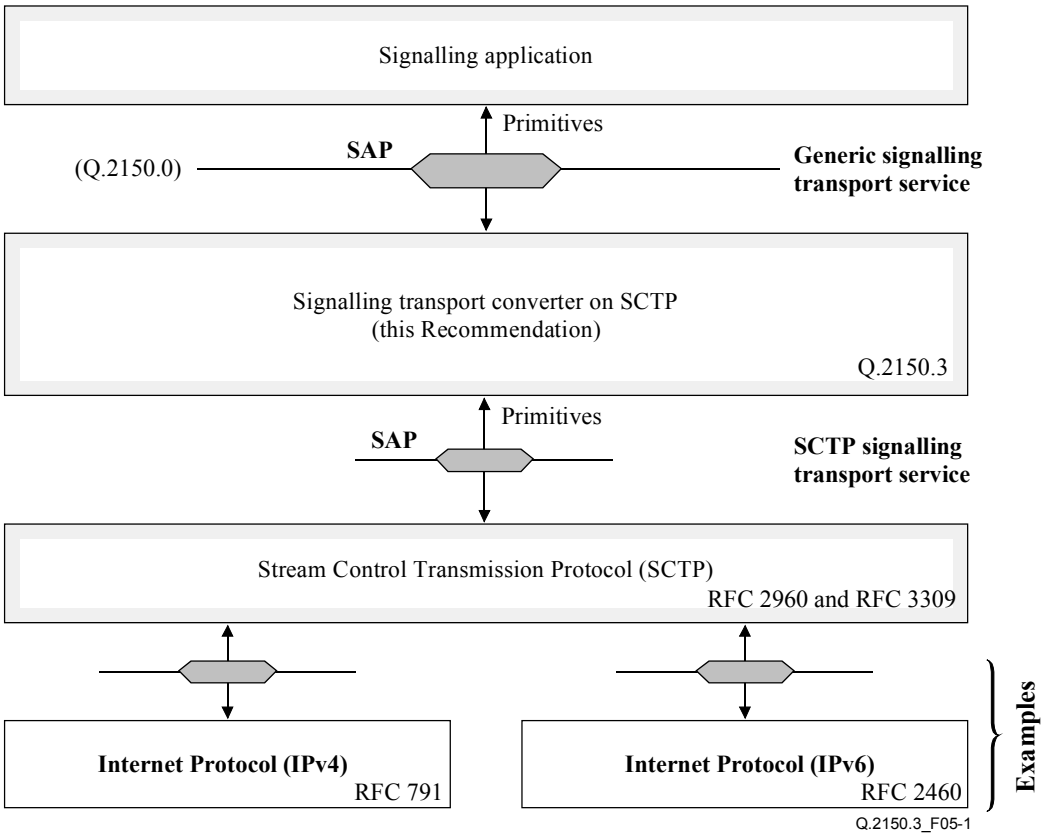

Figure 5-1/Q.2150.3 – Structure of the Signalling Transport Converter on SCTP

5.2 Services provided by the STC

The STC provides for the transparent transfer of data, i.e., signalling application (STC user) data between peer STC users. The supporting communication resources to achieve this transfer stay invisible to the signalling application.

In particular, the STC service provides for:

a) *Independence from the underlying transmission media*

The STC service relieves its users from all concerns of the manner in which the STC service is provided. Except for possible influences of the quality of service, the transfer of data over different underlying networks is, thus, invisible.

b) *Transparency of the information transferred*

The STC service provides for the transparent transfer of octet-aligned STC user data. It does not restrict the content, format, or coding of the information, nor is there ever a need to interpret its structure or meaning.

c) *Management of associations*

The STC service provides for a permanent connection service. As the underlying service (SCTP) needs to have a signalling association established, the STC establishes and maintains this connection on behalf of its user; the user is informed about the availability/unavailability of the data transfer service.

5.3 Functions of the STC

The STC performs the following functions:

a) *Association establishment and maintenance*

This function provides for the establishment and maintenance of an SCTP signalling association. The STC will attempt to reestablish a new SCTP association on behalf of its user in the event of loss of SCTP connectivity.

b) *Service availability reporting to the STC user*

This function reports the availability or unavailability of an SCTP service to the STC user and also to Layer Management.

c) *Maximum length indication to the STC user*

This function indicates to the STC user the maximum length of the PDU that the STC can transfer; indicated at creation of the STC entity.

d) *Call Instance Code (CIC) control indication to the STC user*

This function indicates to the STC user, at creation of the STC entity, whether it serves as the controlling node of the call association.

In addition, the following SCTP services are used:

a) Acknowledged error-free non-duplicated transfer of user data.

b) Sequenced delivery of user messages within single streams.

Also, the following SCTP services may be used:

a) Data fragmentation to conform to discovered path MTU size.

b) Sequenced delivery of user messages within multiple streams.

c) Bundling of multiple user messages into a single SCTP packet.

d) Network-level fault tolerance through supporting of multi-homing at either or both ends of an association.

e) Appropriate IP congestion avoidance behaviour.

6 Elements for layer-to-layer communication

6.1 The generic signalling transport service

The Generic Signalling Transport Service is specified in ITU-T Rec. Q.2150.0 [1]. For convenience, a summary of the primitives for accessing the service is reproduced in Table 6-1. In the event of any difference between this table and the definitions in ITU-T Rec. Q.2150.0 [1], the definitions in ITU-T Rec. Q. 2150.0 [1] take precedence.

Table 6-1/Q.2150.3 – Primitives and parameters of the generic signalling transport sublayer

Primitive generic name	Type			
	Request	Indication	Response	Confirm
START-INFO	–	Max_Length CIC_Control	–	–
IN-SERVICE	–	Level	–	–
OUT-OF-SERVICE	–	(Note 1)	–	–
CONGESTION	–	Level	–	–
TRANSFER	Sequence Control STC User Data Priority (Note 2)	STC User Data Priority (Note 2)	–	–
– : This primitive is not defined. NOTE 1 – This primitive has no parameters. NOTE 2 – This parameter is a national option (use of this parameter is not supported by this signalling transport).				

On the establishment of a signalling transport converter entity and the associated signalling transport converter user entity, for example at power up, the initial conditions are the same as if an OUT-OF-SERVICE.indication primitive had been conveyed across this SAP. Also, at this time, the START-INFO.indication is sent to the signalling entity.

6.2 The Service provided by SCTP

This clause specifies the information flow across the Signalling Transport Converter – SCTP boundary. This boundary is defined in clause 10 of IETF RFC 2960 [2] and summarized below. In the event of any difference between the following summary and the definitions in IETF RFC 2960 [2], the definitions in IETF RFC 2960 [2] take precedence.

The primitives and mandatory attributes (parameters) between STC and SCTP are shown in Tables 6-2 and 6-3.

NOTE – This service corresponds to the "Specific Signalling Transport Service" in Figure 5-1/Q.2150.0.

Table 6-2/Q.2150.3 – STC to SCTP primitives and mandatory attributes of the stream control transmission protocol

Primitives STC to SCTP	Type	
	Request	Confirm
SCTP-INITIALIZE	No mandatory attributes	Local SCTP Instance Name
SCTP-ASSOCIATE	Local SCTP Instance Name, Destination Transport Address, Outbound Stream Count	Association ID
SCTP-SHUTDOWN	Association ID (Note 1)	Result (success or error) (Note 3)
SCTP-ABORT	Association ID (Note 1)	Result (success or error) (Note 3)
SCTP-SEND	Association ID, Buffer Address, Byte Count	Result (success or error) (Note 3)
SCTP-SET_PRIMARY	Association ID, Destination Transport Address (Note 1)	Result (success or error) (Note 3)
SCTP-RECEIVE	Association ID, Buffer Address, Buffer Size	Byte Count
SCTP-STATUS	Association ID (Note 1)	Status Data

Table 6-2/Q.2150.3 – STC to SCTP primitives and mandatory attributes of the stream control transmission protocol

Primitives STC to SCTP	Type	
	Request	Confirm
SCTP-CHANGE_HEARTBEAT	Association ID, Destination Transport Address, New state (Note 1)	Result (success or error) (Note 3)
SCTP-REQUEST_HEARTBEAT	Association ID, Destination Transport Address (Note 1)	Result (success or error) (Note 3)
SCTP-GET_SRTT_REPORT	Association ID, Destination Transport Address (Note 1)	SRTT Result
SCTP-SET_FAILURE_THRESHOLD	Association ID, Destination Transport Address, Failure Threshold (Note 1)	Result (success or error) (Note 3)
SCTP-SET_PROTOCOL_PARAMETERS	Association ID, Protocol Parameter List (Note 1)	Result (success or error) (Note 3)
SCTP-RECEIVE_UNSENT_MESSAGE	Data Retrieval ID, Buffer Address, Buffer Size (Note 2)	–
SCTP-RECEIVE_UNACKED_MESSAGE	Data Retrieval ID, Buffer Address, Buffer Size (Note 2)	–
SCTP-DESTROY	Local SCTP Instance Name (Note 1)	–

– : This primitive is not defined.

NOTE 1 – This primitive is mapped to an STC-Layer Management primitive.

NOTE 2 – This primitive is not used by the STC and are included here for completeness.

NOTE 3 – The values assigned to these result indications (success or error) are implementation dependent.

Table 6-3/Q.2150.3 – SCTP to STC primitives and mandatory attributes of the stream control transmission protocol

Primitives SCTP to STC	Type
	Notification
SCTP-DATA_ARRIVE	(Note 2)
SCTP-SEND_FAILURE	(Note 2) (Note 1)
SCTP-NETWORK_STATUS_CHANGE	Association ID, Destination Transport Address, New Status (Note 1)
SCTP-COMMUNICATION_UP	Association ID, Status, Destination Transport Address List, Outbound Stream Count, Inbound Stream Count (Note 1)
SCTP-COMMUNICATION_LOST	Association ID, Status (Note 1)
SCTP-COMMUNICATION_ERROR	(Note 2) (Note 1)
SCTP-RESTART	(Note 2) (Note 1)
SCTP-SHUTDOWN_COMPLETE	(Note 2) (Note 1)

NOTE 1 – This primitive is mapped to an STC-Layer Management primitive.

NOTE 2 – No mandatory attributes.

6.2.1 Primitive definition

The definition of these primitives is as follows:

a) **SCTP-INITIALIZE**

This request primitive instructs the SCTP to initialise its internal data structures and allocate necessary resources for setting up its operation environment. The SCTP will return a local instance name.

b) **SCTP-ASSOCIATE**

This request primitive allows the STC to initiate a signalling association towards a peer endpoint. An Association ID is returned upon successful establishment.

c) **SCTP-SHUTDOWN**

This request primitive instructs the SCTP to gracefully close an SCTP association. Upon successful acknowledgement by the peer of all traffic sent, a success code is returned.

d) **SCTP-ABORT**

This request primitive instructs the SCTP to ungracefully close an SCTP association. A success code is returned upon successful aborting if the association.

e) **SCTP-SEND**

This request primitive allows the SCTP user to send data over the signalling association.

f) **SCTP-SET_PRIMARY**

This request primitive instructs the SCTP to use the specified destination transport address as primary path for sending packets. An acknowledgement is returned by the SCTP upon successful processing.

g) **SCTP-RECEIVE**

This request primitive allows the STC to retrieve the first message from in the SCTP receive queue.

h) **SCTP-STATUS**

This request primitive instructs the SCTP to return a status of an SCTP association.

i) **SCTP-CHANGE_HEARTBEAT**

This request primitive allows the STC to enable or disable heartbeat on the specified destination transport address. A result is returned acknowledging the action.

j) **SCTP-REQUEST_HEARTBEAT**

This request primitive allows the STC to instruct the SCTP to perform a heartbeat of the specified destination address. An indication of success is returned if the transmission of the heartbeat was successful.

k) **SCTP-GET_SRTT_REPORT**

This request primitive requests the SCTP to report the current Smoothed Round Trip Time measurement on the specified destination transport address. The returned result contains the most recent SRTT.

l) **SCTP-SET_FAILURE_THRESHOLD**

This request primitive instructs the SCTP to change the reachability failure detection threshold 'Path.Max.Retrans' for the specified destination address. A result is returned.

m) **SCTP-SET_PROTOCOL_PARAMETERS**

This request primitive allows the STC to adjust SCTP protocol parameters. A result is returned.

n) **SCTP-RECEIVE_UNSENT_MESSAGE**

This request primitive allows an SCTP-User to retrieve Unsent messages from the SCTP.

o) **SCTP-RECEIVE_UNACKED_MESSAGE**

This request primitive allows an SCTP-User to retrieve Unacknowledged messages from the SCTP.

p) **SCTP-DESTROY**

This request primitive allows the STC to destroy an SCTP instance previously initialized.

q) **SCTP-DATA_ARRIVE**

This notification primitive is issued by SCTP to indicate the SCTP user that a user message is successfully received and ready for retrieval.

r) **SCTP-SEND_FAILURE**

This notification primitive from the SCTP informs the STC when a message cannot be delivered.

s) **SCTP-NETWORK_STATUS_CHANGE**

This notification primitive from the SCTP informs the STC when a destination transport address is marked inactive (e.g., when SCTP detects a failure), or marked active (e.g., when SCTP detects a recovery).

t) **SCTP-COMMUNICATION_UP**

This notification primitive is issued by the SCTP to indicate to the STC that the SCTP signalling association is available, or when a lost communication to an endpoint is restored.

u) **SCTP-COMMUNICATION_LOST**

This notification primitive is issued by the SCTP to indicate to the STC that the SCTP signalling association is now unavailable.

v) **SCTP-COMMUNICATION_ERROR**

This notification primitive is issued by the SCTP to indicate to the STC that an error in the SCTP association has occurred.

w) **SCTP-RESTART**

This notification primitive is sent from the SCTP when it detects the peer has restarted.

x) **SCTP-SHUTDOWN_COMPLETE**

This notification primitive is sent from the SCTP when it successfully completes a shutdown procedure.

6.2.2 Attributes definition

Attributes of the primitives in Tables 6-2 and 6-3 are not defined in this Recommendation. Please refer to IETF RFC 2960 [2] and RFC 3309 [5] for detailed description of the mandatory and optional attributes. Some mandatory and optional attributes are described below to better understand the operation of the STC, but IETF RFC 2960 [2] and RFC 3309 [5] are definitive.

a) **Association ID**

This attribute is the local identifier of the SCTP association.

b) **Destination Transport Address**

This parameter specifies the peer endpoint transport address with which the SCTP association is to be established. The value of this parameter is mapped from STC_DTA provisioned parameter.

NOTE – When several destination transport IP addresses have been provisioned to the STC, one of the highest priority shall be used to initiate the association towards the remote STC entity.

c) **Destination Transport Address List**

This parameter specifies the peer endpoint transport addresses with which the SCTP association has been established. The parameter is returned in an SCTP Communication Up message and is stored in the local STC_DTAL parameter.

d) **Outbound Stream Count**

This parameter specifies the number of outbound streams the SCTP user wishes to open towards a peer endpoint. The value of this parameter is mapped from STC_OS provisioned parameter.

e) **Buffer Address**

In a Send request primitive, the Buffer Address indicates where the user message to be transmitted is stored. In a Receive request primitive, the Buffer Address is the memory location indicated by the STC to store the received message. This is an implementation dependent way of describing the transfer of STC User Data between the STC and the SCTP.

f) **Payload Protocol Identifier**

This optional attribute in the Send and Receive primitive that specifies the type of payload protocol data that is transported by SCTP. The value of this parameter is mapped from STC_PI provisioned parameter. The SCTP Payload Protocol Identifier values are assigned by IANA (see clause 13.4 of IETF RFC 2960 [2]).

g) **Heartbeat New State**

This attribute in the SCTP-Change_Heartbeat primitive sets the heartbeat state on the specified destination transport address (enabled/disabled).

6.3 Primitives between the STC and layer management

This clause specifies the information flow across the STC – Layer Management boundary.

The repertoire of primitives between STC and layer management is listed in Table 6-4.

Table 6-4/Q.2150.3 – Primitives and parameters between the STC and layer management

Primitive generic name	Type	
	Request	Confirmation/Indication
MSTC-SCTP-SHUTDOWN	Association ID (Note 1)	–
MSTC-SCTP-ABORT	Association ID (Note 1)	–
MSTC-SCTP-SET_PRIMARY	Association ID, Destination Transport Address (Note 1)	Result (success or error) (Note 3)
MSTC-SCTP-STATUS	Association ID (Note 1)	Status Data
MSTC-SCTP-CHANGE_HEARTBEAT	Association ID, Destination Transport Address, New state (Note 1)	Result (success or error) (Note 3)
MSTC-SCTP-REQUEST_HEARTBEAT	Association ID, Destination Transport Address (Note 1)	Result (success or error) (Note 3)
MSTC-SCTP-GET_SRTT_REPORT	Association ID, Destination Transport Address (Note 1)	SRTT Result
MSTC-SCTP-SET_FAILURE_THRESHOLD	Association ID, Destination Transport Address, Failure Threshold (Note 1)	Result (success or error) (Note 3)
MSTC-SCTP-SET_PROTOCOL_PARAMETERS	Association ID, Protocol Parameter List (Note 1)	Result (success or error) (Note 3)

Table 6-4/Q.2150.3 – Primitives and parameters between the STC and layer management

Primitive generic name	Type	
	Request	Confirmation/Indication
MSTC-SCTP-DESTROY	Local SCTP Instance Name (Note 1)	–
MSTC-SCTP-SEND_FAILURE	–	(Note 1) (Note 2)
MSTC-SCTP-NETWORK_STATUS_CHANGE	–	Association ID, Destination Transport Address, New Status (Note 1)
MSTC-SCTP-COMMUNICATION_UP	–	Transport Address List, Outbound Stream Count, Inbound Stream Count (Note 1)
MSTC-SCTP-COMMUNICATION_LOST	–	Association ID, Status (Note 1)
MSTC-SCTP-COMMUNICATION_ERROR	–	(Note 1) (Note 2)
MSTC-SCTP-RESTART	–	(Note 1) (Note 2)
MSTC-SCTP-SHUTDOWN_COMPLETE	–	(Note 1) (Note 2)

– : This primitive is not defined.

NOTE 1 – This primitive is mapped from/to an SCTP primitive.

NOTE 2 – This primitive has no attributes.

NOTE 3 – The values assigned to these result indications (success or error) are implementation dependent.

6.3.1 Primitive definition

All the MSTC request, confirmation and indication primitives map directly to corresponding SCTP request, confirmation and notification primitives in Tables 6-2 and 6-3.

7 Protocol elements for peer-to-peer communication

7.1 STC messages (STC-PDUs)

7.1.1 STC PDU formats

The following STC messages (PDUs) are used for exchanging information between peer STC entities:

a) **STC signalling message**

This PDU is used for carrying STC signalling messages to a peer STC entity via the IP network. The length of such a signalling message may not exceed the maximum length indicated in the Max_Length parameter. The STC is not adding any Protocol Control Information to the message. Figure 7-1 illustrates the format of the STC PDU.

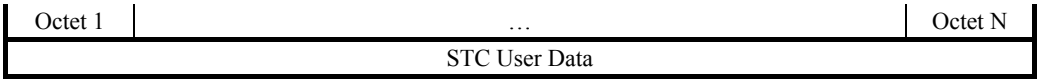

Figure 7-1/Q.2150.3 – STC signalling message PDU

7.1.2 STC signalling message PDU fields

An STC Signalling Message PDU contains the following field:

- **STC User Data field**

  This field in the STC Signalling Message PDU contains a complete STC-SDU.

7.2 STC state variable

The STC maintains the following state variable:

a) Current availability state of the SCTP association instance.

7.3 STC timers

The STC entity requires the following timer:

a) **Timer_DELAY**

When this timer is running, the SCTP service is unavailable. It protects the unnecessary consumption of resources if an SCTP association could not be established or has been released. Expiry of this timer leads to a reestablishment attempt of the SCTP association. For the timer value, refer to 7.4.

7.4 Provisioned STC parameters

STC parameters are specified at creation of a new STC entity and they are unchanged during the lifetime of the STC entity. The following parameters are defined:

a) **STC_DTA**

The value of this parameter specifies the remote destination transport IP address used by the STC entity to initiate an SCTP association. It can be set to an IPv4 [9], IPv6 [10] and/or Host Name type addresses (see clause 3.3.2 of IETF RFC 2960 [2]).

b) **STC_DTAL**

The value of this parameter specifies the (set of) remote destination transport IP address(es) returned to the STC as the remote destination addresses to be used for the SCTP association. They can be set to IPv4 [9], IPv6 [10] and/or Host Name type addresses (see clause 3.3.2 of IETF RFC 2960 [2]).

NOTE – When more than one destination IP addresses are available, it shall be possible to assign priorities to each of them. This can be used to provide load sharing between different IP addresses or provide a priority list for the different IP addresses for the association.

c) **STC_LEAL (optional)**

The Local Eligible Address List is the local IP addresses that the local SCTP endpoint should bind at initialization. If not supplied by the STC, by default all IP addresses assigned to the Host should be used by the local endpoint. (See clause 10.1 of IETF RFC 2960 [2].) The LEAL is optionally included in the outgoing SCTP_ASSOCIATE request primitive. If not included in this primitive, the SCTP layer provides this information in the outgoing INITIATION (INIT) message.

d) **STC_OS**

The value of this parameter specifies the number of outbound streams the STC wishes to open to the peer STC entity.

e) **STC_PI**

The value of this parameter identifies the payload protocol that is transported by SCTP. The SCTP Payload Protocol Identifier values are assigned by IANA (see clause 13.4 of IETF RFC 2960 [2]).

f) **Value of Max_Length**

The value of this parameter can be set to, for example "272", "4096" or "65 534". The value to be provisioned is chosen by the network operators.

NOTE 1 – The values "272", "4096" and "65 534" are used for interworking with MTP3 [12], MTP3b [13] and SSCOP [11] networks respectively.

NOTE 2 – If the value of this parameter exceeds the discovered path MTU size, then the fragmentation/reassembly functionality is provided by SCTP. It should be noted that, in this case, the partial delivery option of SCTP may be used for the case of temporary resource shortage at the receiving SCTP entity, utilising the optional "partial flag" attribute of the SCTP_RECEIVE primitive. See clause 6.9 of IETF RFC 2960 [2] (Fragmentation/Reassembly).

g) **CIC_Control**

This value is used in the CIC_Control parameter of the START-INFO primitive; it indicates to the STC user whether it controls the **EVEN** or **ODD** CIC values of the call association.

NOTE – One STC of the signalling association must control the odd CIC values; the other must control the even CIC values. Inconsistent provisioning will result in faulty operation of the STC user dual seizure procedure.

h) **Value of Timer_DELAY**

The value of Timer_DELAY can be in the range of 800 to 1500 ms.

i) **Client_Server_Designation**

This parameter is used to designate whether the STC entity requests initiation of the SCTP association or whether it receives the SCTP association initiation request. The STC entity which is designated to request initiation of the SCTP association is defined as the "SCTP Client"; it's peer STC entity is defined as the "SCTP Server".

NOTE – One STC of the signalling association must be designated as the SCTP Client; the other must be designated as the SCTP Server. Inconsistent provisioning will result in faulty operation of the SCTP initiation procedures.

8 Specification of the STC

8.1 Overview

The following states are used in the specification of the peer-to-peer protocol. The states are conceptual and reflect the general condition of the STC entity in the sequences of primitives and PDU exchanges with its user, peer, underlying sublayer.

8.1.1 State 1: Service Unavailable

In this state, no data is sent in either direction. The STC is not able to transfer STC user signalling messages.

If the STC user submits data for transfer with the TRANSFER.request primitive, the primitive is ignored.

8.1.2 State 2: STC Association Establishment

In this state, SCTP service is not yet available. The STC instructs the SCTP to establish a new association with its peer and awaits the peer's response.

If the STC user submits data for transfer with the TRANSFER.request primitive, the primitive is ignored.

8.1.3 State 3: STC Service Available

In this state, SCTP service is available and data transfer takes place.

8.2 Procedures of the STC

8.2.1 Initial Conditions

This clause specifies how the STC operates at power up.

When the STC entity is initialised, the STC requests the SCTP sublayer to initialise the SCTP resources with an SCTP-INITIALIZE.request primitive. If applicable, the optional Local Eligible Address List will be included.

Upon confirmation, the STC will send a START-INFO.indication primitive containing the CIC_Control and the Max_Length parameters.

If the STC is designated the SCTP Client (see 7.4 item i), the STC will request the SCTP to establish a signalling association with the peer STC entity with an SCTP-ASSOCIATE.request primitive. The Destination Transport Address attribute and Outbound Stream Count will be included.

When SCTP-COMMUNICATION_UP.indication primitive is received, the STC then sends an IN-SERVICE.indication primitive to STC user (the use of the Congestion Level parameter in this primitive is for further study).

The attributes carried in these primitives are shown in Table 8-1.

Table 8-1/Q.2150.3 – Primitives and parameters in the initialise and associate procedure

Primitive	Attributes	Content
SCTP-INITIALIZE.request	Local Eligible Address List (optional)	Value of STC_LEAL (optional)
SCTP-ASSOCIATE.request (Note 1)	Destination Transport Address	Value of STC_DTA provisioned parameter
	Outbound Stream Count (Note 2)	Value of STC_OS provisioned parameter
SCTP-COMMUNICATION_UP. indication	Destination Transport Address List	STC-DTAL (Note 2)
	Outbound Stream Count (Note 2)	
NOTE 1 – SCTP Client side only. NOTE 2 – The Outbound Stream Count parameter may be changed during the establishment of the SCTP association. The STC shall record the new values for further possible utilisation in the signalling data transfer phase. The actions performed in the case that the received destination transport addresses do not match information held locally in provisioned parameter STC_DTAL, are an implementation matter.		

Once the SCTP signalling association is established, the SCTP will, by default, monitor the reachability of any destination transport addresses in the association with the Heartbeat procedure. Layer management can disable or change the frequency of the Heartbeat to a destination transport address by issuing an MSTC-SCTP-CHANGE_HEARTBEAT.request primitive. This primitive is mapped to an SCTP-CHANGE_HEARTBEAT.request primitive to the SCTP. The change in frequency of the Heartbeat is achieved by utilizing the optional "interval" attribute of the SCTP-CHANGE_HEARTBEAT.request primitive.

Layer Management may optionally request the SCTP to test the reachability of a destination transport address through the MSTC-SCTP-REQUEST_HEARTBEAT.request primitive. This primitive is mapped to an SCTP-REQUEST_HEARTBEAT.request primitive to the SCTP.

8.2.2 STC signalling message transfer procedure

8.2.2.1 Sending a signalling message

Upon receipt of a TRANSFER.request primitive from STC user, the STC shall place the signalling message unaltered into a Signalling Message PDU and optionally select the destination transport address from the Destination Transport Address List.

The STC must ensure that STC user messages related to a specific received Sequence Control parameter value map to the same SCTP stream in order to maintain in-sequence delivery. Messages related to different sequences may be mapped to different streams.

It shall then transfer the PDU to the SCTP using the SCTP-SEND.request primitive. The primitive carries the parameters shown in Table 8-2.

Table 8-2/Q.2150.3 – Parameters in the SCTP-SEND.request primitive

Attributes	Content
"Message Data"	Unaltered Signalling Message as received in the STC User Data parameter
Destination Transport Address (Note 1)	(Note 2)
Stream Number (Note 1)	Value derived from Sequence Control parameter (Note 2)
Payload Protocol ID (Note 1)	Value of STC_PI provisioned parameter
NOTE 1 – This parameter is optional NOTE 2 – The mapping of the Sequence Control parameter onto a designation of the Stream Number and Destination IP address, is an implementation matter.	

8.2.2.2 Receiving a signalling message

Upon receipt of an SCTP-DATA-ARRIVE.indication primitive from SCTP, the STC will request the retrieval of the STC user signalling message with SCTP-RECEIVE.request primitive. The STC shall pass the SCTP user data unaltered to the STC user in a TRANSFER.indication primitive.

8.2.3 Destination availability procedure

On the reception of an SCTP-COMMUNICATION_LOST.indication primitive from the SCTP, the STC will indicate the unavailability of the data transfer to the STC user with an OUT-OF-SERVICE.indication primitive. Layer Management is also informed via an MSTC-SCTP-COMMUNICATION_LOST.indication primitive. At the SCTP Client side, Timer_DELAY is started.

On the reception of an SCTP-COMMUNICATION_UP.indication primitive from the SCTP, the STC will indicate the availability of the data transfer to the STC user with an IN-SERVICE.indication primitive (the value of Congestion Level parameter in this primitive is implementation dependent). Timer_Delay is cancelled if running. Layer Management is also informed via an MSTC-SCTP-COMMUNICATION_UP.indication primitive.

On expiry of Timer_Delay, the STC will request the SCTP to establish a signalling association with the peer STC entity with an SCTP-ASSOCIATE.request primitive, as described in 8.2.1.

NOTE – The congestion notification from SCTP to the STC is an implementation-dependent matter. In general, the STC shall handle the congestion event received from SCTP and provide the means to report to STC user with CONGESTION.indication primitive (with a Congestion Level parameter).

8.3 State transition table

The State Transition Table (Table 8-3) for STC describes the primitives and primitives that lead to state transitions.

Table 8-3/Q.2150.3 – State transition table

Event	State		
	1 **STC service unavailable**	**2** **STC association establishment**	**3** **STC service available**
Power Up (SCTP Server)	• SCTP-INITIALIZE request to SCTP • START-INFO to STC user → 1	–	–
Power Up (SCTP Client)	• SCTP-INITIALIZE request to SCTP • START-INFO to STC user • SCTP-ASSOCIATE to SCTP → 2	–	–
SCTP-COMMUNICATION_UP.indication	• IN-SERVICE.indication → 3 (Note 1)	• IN-SERVICE.indication → 3	–
SCTP-COMMUNICATION_LOST.indication	–	• OUT-OF-SERVICE.indication • Start Timer_DELAY (Note 2) → 1	• OUT-OF-SERVICE.indication • Start Timer_DELAY (Note 2) → 1
TRANSFER.request	Discard → 1	Discard → 2	SCTP-SEND.request → 3
SCTP-RECEIVE.request	Discard → 1	Discard → 2	TRANSFER.indication → 3
Timer_DELAY expiry	SCTP-ASSOCIATE to SCTP → 2	–	–
NOTE 1 – SCTP Server side only. For SCTP Client side no action. NOTE 2 – SCTP Client side only. For SCTP Server side no action.			

Appendix I

Protocol Implementation Conformance Statement (PICS) Proforma

There exist no actions of the Signalling Transport Converter that are visible from outside a system, therefore a Protocol Implementation Conformance Statement is not possible. If the Generic Signalling Transport Service is based on SCTP, all of clauses 7 and 8 of this Recommendation apply.

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