                  Telephony Signalling Transport over
   Stream Control Transmission Protocol (SCTP) Applicability Statement

Status of This Memo

Copyright Notice

Abstract

   This document describes the applicability of the several protocols
   developed under the signalling transport framework. A description of
   the main issues regarding the use of the Stream Control Transmission
   Protocol (SCTP) and an explanation of each adaptation layer for
   transport of telephony signalling information over IP infrastructure
   are given.

Table of Contents

1. Introduction

   This document is intended to describe how to transport telephony
   signalling protocols, used in classic telephony systems, over IP
   networks. As described in [RFC2719], the whole architecture is
   called SIGTRAN (Signalling Transport) and is composed of a transport
   protocol (SCTP) and several User Adaptation Layers (UALs). The
   transport protocol SCTP has been developed to fulfill the stringent
   requirements of telephony signalling networks [RFC3257]. The set of
   UALs has also been introduced to make it possible for different
   signalling protocols to use the SCTP layer.

1.1. Scope

   The scope of this document is the SIGTRAN user adaptation layers and
   SCTP protocols and how they are used to transport telephony
   signalling information over IP networks.

1.2. Terminology

   The following terms are commonly identified in related work:

   Association: SCTP connection between two endpoints.

   Stream: A uni-directional logical channel established within an
                association, within which all user messages are
                delivered in sequence except for those submitted to the
                unordered delivery service.

   SPU: Signalling protocol user, the application on top of the
                User adaptation layer.

   CTSP: Classical Telephony Signalling Protocol (examples
                include: MTP level 2, MTP level 3, and SCCP).

   UAL: User Adaptation Layer, the protocol that encapsulates
                the upper layer telephony signalling protocols that are
                to be transported over SCTP/IP.

   ISEP: IP Signalling Endpoint, an IP node that implements SCTP
                and a User adaptation layer.

   SP: Signalling Point.

1.3. Contributors

   The following people contributed to the document: L. Coene (Editor),
   M. Tuexen, G. Verwimp, J. Loughney, R.R. Stewart, Qiaobing Xie, M.
   Holdrege, M.C. Belinchon, A. Jungmaier, J. Pastor, and L. Ong.

2. SIGTRAN Architecture

   The SIGTRAN architecture describes the transport of signalling
   information over IP infrastructure.

Telephony signalling transport over IP normally uses the following
architecture:

```
                 Telephony Signalling Protocol
                              |
             +------------------------------------+
             |         User Adaptation Layers     |
             +------------------------------------+
                              |

             +------------------------------------+
             |Stream Control Transmission Protocol|
             |               (SCTP)               |
             +------------------------------------+
                              |
                 Internet Protocol (IPv4/IPv6)
```
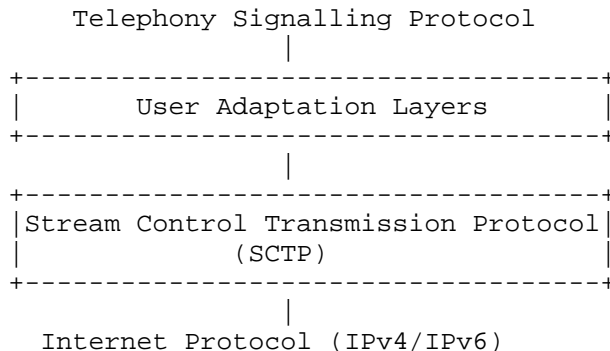
           Figure 1: Telephony SIGnalling TRANsport Protocol Stack

The components of the protocol stack are:

1. Adaptation layers used when the telephony application needs to
    preserve an existing primitive interface (e.g., management
    indications or data operation primitives for a particular
    user/application protocol).
2. SCTP, specially configured to meet the telephony application
    performance requirements.
3. The standard Internet Protocol.

The telephony signalling protocols to be transported can be:

o [RFC3332] SS7 MTP3 users: SCCP, ISUP, TUP...
o [RFC3331] SS7 MTP2 users: MTP3
o [RFC3868] SS7 SCCP users: RANAP, MAP(+TCAP), INAP(+TCAP)...
o [RFC3057] ISDN Q.921 users: Q.931
o [RFC3807] V5.2 / DSS1
o ....

The user adaptation layers (UALs) are a set of protocols that
encapsulate a specific signalling protocol to be transported over
SCTP. The adaption is done in a way that the upper signalling
protocols, which are relayed, remain unaware that the lower layers
are different from the original lower telephony signalling layers.
In that sense, the upper interface of the user adaptation layers
needs to be the same as the upper layer interface is to its original
lower layer. If a MTP user is being relayed over the IP network, the
related UAL used to transport the MTP user will have the same upper
interface as MTP has.

The Stream Control Transmission Protocol was designed to fulfill the
stringent transport requirements that classical signalling protocols
have and is therefore the recommended transport protocol to use for
this purpose.

SCTP provides the following functions:

o Reliable Data Transfer
o Multiple streams to help avoid head-of-line blocking
o Ordered and unordered data delivery on a per-stream basis
o Bundling and fragmentation of user data
o Congestion and flow control
o Support for continuous monitoring of reachability
o Graceful termination of association
o Support of multi-homing for added reliability
o Protection against blind denial-of-service attacks
o Protection against blind masquerade attacks

SCTP is used as the transport protocol for telephony signalling
applications. Message boundaries are preserved during data transport
by SCTP, so each UAL can specify its own message structure within the
SCTP user data. The SCTP user data can be delivered by the order of
transmission within a stream (in sequence delivery) or unordered.

SCTP can be used to provide redundancy at the transport layer and
below. Telephony applications needing this level of redundancy can
make use of SCTP's multi-homing support.

SCTP can be used for telephony applications where head-of-line
blocking is a concern. Such an application should use multiple
streams to provide independent ordering of telephony signalling
messages.

3. Issues for Transporting Telephony Signalling over SCTP

Transport of telephony signalling requires special considerations.
In order to use SCTP, an implementation must take special care to
meet the performance, timing, and failure management requirements.

3.1. Congestion Control

The basic mechanism of congestion control in SCTP has been described
in [RFC2960]. SCTP congestion control sometimes conflicts with the
timing requirements of telephony signalling application messages
which are transported by SCTP. During congestion, messages may be
delayed by SCTP, thus sometimes violating the timing requirements of
those telephony applications.

In an engineered network (e.g., a private intranet), in which network capacity and maximum traffic are very well controlled, some telephony signalling applications may choose to relax the congestion control rules of SCTP in order to satisfy the timing requirements. In order to do this, they should employ their own congestion control mechanisms. This must be done without destabilizing the network; otherwise, it would lead to potential congestion collapse of the network.

Some telephony signalling applications may have their own congestion control and flow control techniques. These techniques may interact with the congestion control procedures in SCTP.

3.2. Detection of Failures

Often, telephony systems must have no single point of failure in operation.

The UAL must meet certain service availability and performance requirements according to the classical signalling layers they are replacing. Those requirements may be specific for each UAL.

For example, telephony systems are often required to be able to preserve stable calls during a component failure. Therefore, error situations at the transport layer and below must be detected quickly so that the UAL can take appropriate steps to recover and preserve the calls. This poses special requirements on SCTP to discover unreachability of a destination address or a peer.

3.2.1. Retransmission TimeOut (RTO) Calculation

The SCTP protocol parameter RTO.Min value has a direct impact on the calculation of the RTO itself. Some telephony applications want to lower the value of the RTO.Min to less than 1 second. This would allow the message sender to reach the maximum number-of-retransmission threshold faster in the case of network failures. However, lowering RTO.Min may have a negative impact on network behaviour [ALLMAN99].

In some rare cases, telephony applications might not want to use the exponential timer back-off concept in RTO calculation in order to speed up failure detection. The danger of doing this is that, when network congestion occurs, not backing off the timer may worsen the congestion situation. Therefore, this strategy should never be used on the public Internet.

It should be noted that not using delayed SACK will also increase the speed of failure detection.

3.2.2. Heartbeat

   For faster detection of (un)availability of idle paths, the telephony
   application may consider lowering the SCTP parameter HB.interval. It
   should be noted this might result in a higher traffic load.

3.2.3. Maximum Number of Retransmissions

   Setting Path.Max.Retrans and Association.Max.Retrans SCTP parameters
   to lower values will speed up both destination address and peer
   failure detection. However, if these values are set too low, the
   probability of false fault detections might increase.

3.3. Shorten End-to-End Message Delay

   Telephony applications often require short end-to-end message delays.
   The method described in Section 3.2.1 for lowering RTO may be
   considered. The different paths within a single association will
   have a different RTO, so using the path with the lowest RTO will lead
   to a shorter end-to-end message delay for the application running on
   top of the UALs.

3.4. Bundling Considerations

   Bundling small telephony signalling messages at transmission helps
   improve the bandwidth usage efficiency of the network. On the
   downside, bundling may introduce additional delay to some of the
   messages. This should be taken into consideration when end-to-end
   delay is a concern.

3.5. Stream Usage

   Telephony signalling traffic is often composed of multiple,
   independent message sequences. It is highly desirable to transfer
   those independent message sequences in separate SCTP streams. This
   reduces the probability of head-of-line blocking in which the
   retransmission of a lost message affects the delivery of other
   messages not belonging to the same message sequence.

4. User Adaptation Layers

   Users Adaptation Layers (UALs) are defined to encapsulate different
   signalling protocols for transport over SCTP/IP.

   There are UALs for both access signalling (DSS1) and trunk signalling
   (SS7). A brief description of the standardized UALs follows in the
   next sub-sections.

   The delivery mechanism in several UALs supports:

   o Seamless operation of UALs user peers over an IP network
      connection.
   o The interface boundary that the UAL user had with the traditional
      lower layer.
   o Management of SCTP transport associations and traffic between SGs
      and ISEPs or two ISEPs
   o Asynchronous reporting of status changes to management.

   Signalling User Adaptation Layers have been developed for both Access
   and Trunk Telephony Signalling. They are defined as follows.

   Access Signalling: This is the signalling that is needed between an
   access device and an exchange in the core network in order to
   establish, manage, or release the voice or data call paths. Several
   protocols have been developed for this purpose.

   Trunk Signalling: This is the signalling that is used between the
   exchanges inside the core network in order to establish, manage, or
   release the voice or data call paths. The most common protocols used
   for this purpose are known as the SS7 system, which belongs to the
   Common Channel Signalling (CCS) philosophy. The SS7 protocol stack
   is depicted below:

```
         +------+-----+-------+- -+-------+------+-----+------+
         |      |     |       |   |       |  MAP | CAP | INAP |
         +      |     + RANAP |...|  BSSAP +------------------+
         | ISUP | TUP |       |   |       |        TCAP       |
         +      |     +-------------------------------------+
         |      |     |                SCCP                 |
         +-------------------------------------------------+
         |                     MTP3                        |
         +-------------------------------------------------+
         |                     MTP2                        |
         +-------------------------------------------------+
         |                     MTP1                        |
         +-------------------------------------------------+
```
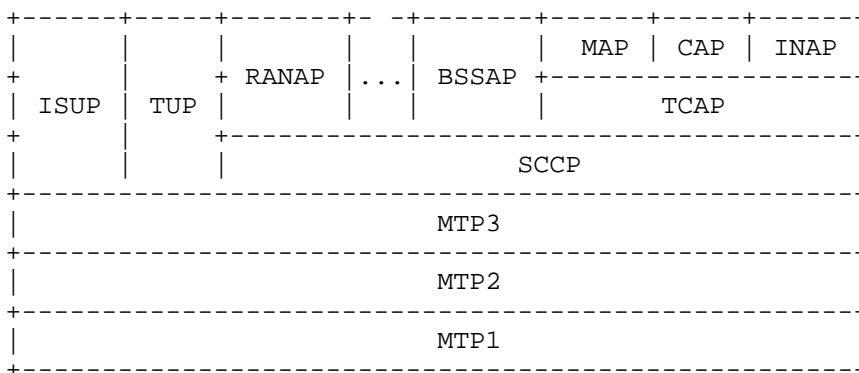
                     Figure 2: SS7 Protocol Stack

The Telephony Signalling Protocols to be transported with the already
designed UALS are:

o ISDN Q.921 Users: Q.931
o V5.2/DSS1
o DPNSS/DASS2 [RFC4129]
o SS7 MTP3 Users: SCCP, ISUP, TUP
o SS7 MTP2 Users: MTP3
o SS7 SCCP Users: TCAP, RANAP, BSSAP, ...

Two main scenarios have been developed to use the different UALS for
IP Signalling Transport:

1. Intercommunication of traditional Signalling transport nodes and
    IP based nodes.

```
                  Traditional               Telephony
                   Telephony                Signalling
         *********  Signalling  **********   over IP    ********
         *  SEP  *----------------*   SG   *--------------* ISEP *
         *********                **********              ********


         +-------+                                        +-------+
         |SigProt|                                        |SigProt|
         +-------+                +----+----+             +-------+
         |       |                |    |UAL |             |  UAL  |
         |       |                |    +----+             +-------+
         | TTST  |                |TTST|SCTP|             | SCTP  |
         |       |                |    +----+             +-------+
         |       |                |    | IP |             | IP    |
         +-------+                +---------+             +-------+


              SEP     -   Signalling Endpoint
              SG      -   Signalling Gateway
              ISEP    -   IP Signalling Endpoint
              SigProt -   Signalling Protocol
              TTSP    -   Traditional Telephony Signalling Protocol
              UAL     -   User Adaptation Layer
              SCTP    -   Stream Control Transport Protocol
```

        Figure 3: General Architecture of SS7-IP Interworking

This is also referred to as SG-to-AS communication. AS is the name
that UAL usually gives to the ISEP nodes. It stands for Application
Server.

2. Communication inside the IP network.

```
                              Telephony
                              Signalling
              *********         over IP        *********
              * ISEP  *------------------*  ISEP *
              *********                        *********


              +-------+                        +-------+
              |SigProt|                        |SigProt|
              +-------+                        +-------+
              | UAL   |                        | UAL   |
              +-------+                        +-------+
              | SCTP  |                        | SCTP  |
              +-------+                        +-------+
              | IP    |                        | IP    |
              +-------+                        +-------+
```
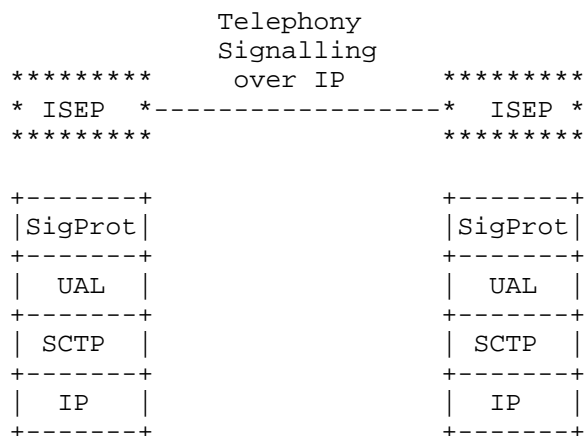
            Figure 4: General Architecture of Intra-IP Communication

   This is also referred to as IPSP communication. IPSP stands for IP
   Signalling Point and describes the role that the UAL plays on an
   IP-based node.

   The first scenario is applied for both types of signalling (access
   and trunk signalling). On the other hand, the peer-to-peer basis can
   only be used for trunk signalling.

4.1. Access Signalling

   The SIGTRAN WG has developed UALs to transport the following Access
   Signalling protocols:

   o   ISDN Q.931
   o   V5.2
   o   DPNSS/DASS2

4.1.1. IUA (ISDN Q.921 User Adaptation)

   UAL: IUA (ISDN Q.921 User Adaptation)

   This document supports both ISDN Primary Rate Access (PRA) as well as
   Basic Rate Access (BRA) including the support for both point-to-point
   and point-to-multipoint modes of communication. This support
   includes Facility Associated Signalling (FAS), Non-Facility
   Associated Signalling (NFAS), and NFAS with backup D channel.

It implements the client/server architecture. The default
orientation is for the SG to take on the role of server while the
ISEP is the client. The SCTP (and UDP/TCP) Registered User Port
Number Assignment for IUA is 9900.

Examples of the upper layers to be transported are Q.931 and QSIG.

The main scenario supported by this UAL is the SG-to-ISP
communication where the ISEP role is typically played by a node
called an MGC, as defined in [RFC2719].

```
              ******   ISDN         ******         IP      *******
              *PBX *--------------* SG *--------------* MGC *
              ******                ******                   *******

              +-----+                                      +-----+
              |Q.931|                 (NIF)                 |Q.931|
              +-----+            +----------+               +-----+
              |     |            |     | IUA|               | IUA |
              |     |            |     +----+               +-----+
              |Q.921|            |Q.921|SCTP|               |SCTP |
              |     |            |     +----+               +-----+
              |     |            |     | IP |               | IP  |
              +-----+            +-----+----+               +-----+

              NIF  - Nodal Interworking Function
              PBX  - Private Branch Exchange
              SCTP - Stream Control Transmission Protocol
              IUA  - ISDN User Adaptation Layer Protocol

              Figure 5: ISDN-IP Interworking using IUA
```
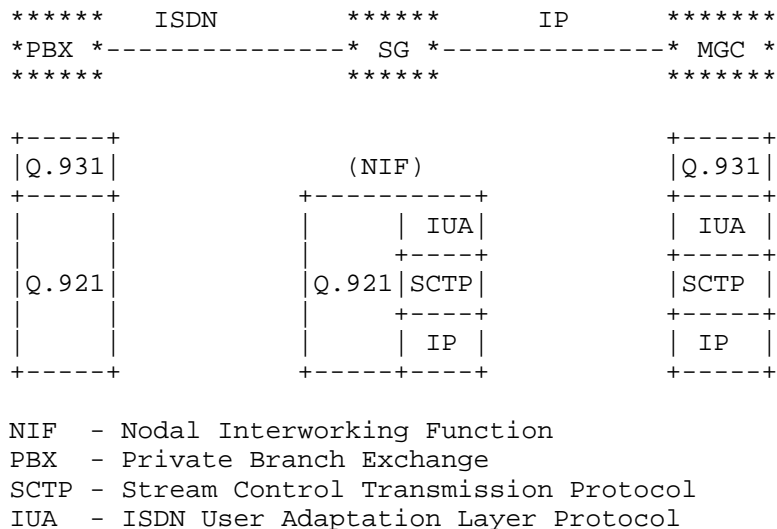
The SCTP (and UDP/TCP) Registered User Port Number Assignment for IUA
is 9900.

The value assigned by IANA for the Payload Protocol Identifier in the
SCTP Payload Data chunk is "1".

4.1.2. V5UA (V5.2-User Adaptation) Layer
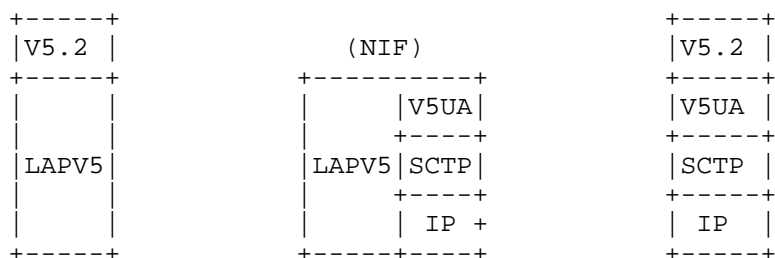
   UAL: V5UA (V5.2-User Adaptation)

   V5UA is an extension from the IUA layer with the modifications needed
   to support the differences between Q.921/Q.931, and V5.2 layer
   2/layer 3. It supports analog telephone access, ISDN basic rate
   access and ISDN primary rate access over a V5.2 interface. It is
   typically implemented in an interworking scenario with SG.

```
             ******    V5.2         ******     IP       *******
             * AN *--------------* SG *--------------* MGC *
             ******                ******            *******


             +-----+                                  +-----+
             |V5.2 |              (NIF)               |V5.2 |
             +-----+          +----------+            +-----+
             |     |          |    |V5UA|            |V5UA |
             |     |          |    +----+            +-----+
             |LAPV5|          |LAPV5|SCTP|            |SCTP |
             |     |          |    +----+            +-----+
             |     |          |    | IP +            | IP  |
             +-----+          +-----+----+            +-----+
```

             AN   - Access Network
             NIF   - Nodal Interworking Function
             LAPV5 - Link Access Protocol for the V5 channel
             SCTP - Stream Control Transmission Protocol

               Figure 6: V5.2-IP Interworking using V5UA
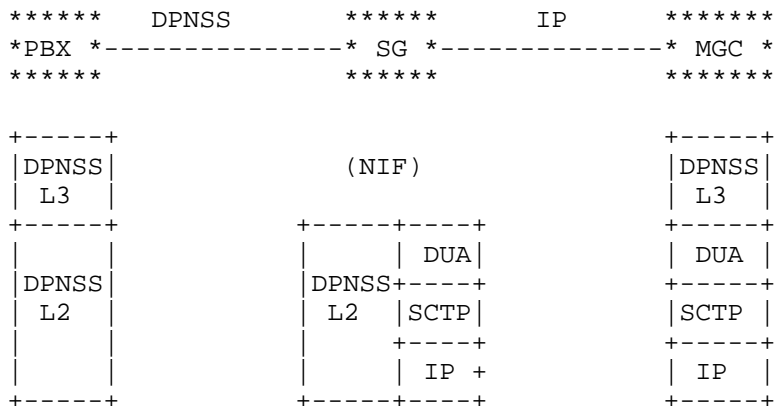
   The SCTP (and UDP/TCP) Registered User Port Number Assignment for
   V5UA is 5675.

   The value assigned by IANA for the Payload Protocol Identifier in the
   SCTP Payload Data chunk is "6".

4.1.3. DUA (DPNSS/DASS User adaptation) Layer

   UAL: DUA (DPNSS/DASS2 User Adaptation)

   The DUA is built on top of IUA and defines the necessary extensions
   to IUA for a DPNSS/DASS2 transport. DPNSS stands for Digital Private
   Network Signalling System and DASS2 for Digital Access Signalling
   System 2.

```
                  ******   DPNSS        ******    IP      *******
                  *PBX *--------------* SG *-------------* MGC *
                  ******                ******            *******


                  +-----+                                +-----+
                  |DPNSS|              (NIF)             |DPNSS|
                  | L3  |                                | L3  |
                  +-----+          +-----+----+          +-----+
                  |     |          |     | DUA|          | DUA |
                  |     |          |     +----+          +-----+
                  |DPNSS|          |DPNSS+----+          +-----+
                  | L2  |          | L2  |SCTP|          |SCTP |
                  |     |          |     +----+          +-----+
                  |     |          |     | IP +          | IP  |
                  +-----+          +-----+----+          +-----+


           PBX  - Private Branch eXchange
           NIF  - Nodal Interworking Function
           SCTP - Stream Control Transmission Protocol
           DUA  - DPNSS User Adaptation Layer Protocol
```

               Figure 7: DPNSS-IP Interworking using DUA

   The value assigned by IANA for the Payload Protocol Identifier in the
   SCTP Payload Data chunk is "10". .

4.2. Network Signalling

   The SIGTRAN WG has developed UALs to transport the following SS7
   protocols:

   o MTP2 Users: MTP3
   o MTP3 Users: ISUP, TUP, SCCP
   o SCCP Users: TCAP, RNSAP, RANAP, BSSAP, ...
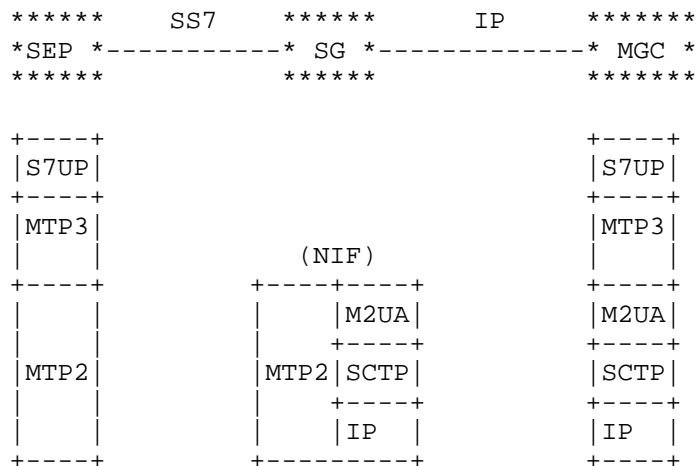
4.2.1. MTP lvl3 over IP

   UALs:

   o M2UA (SS7 MTP2 User Adaptation [RFC3331])
   o M2PA (SS7 MTP2-User Peer-to-Peer Adaptation [RFC4165])

4.2.1.1. M2UA (SS7 MTP2-User Adaptation) Layer

   M2UA protocol is typically used between a Signalling Gateway (SG) and
   Media Gateway Controller (MGC). The SG will terminate up to MTP
   Level 2, and the MGC will terminate MTP Level 3 and above. In other
   words, the SG will transport MTP Level 3 messages over an IP network
   to an MGC.

   MTP3 and MTP3b are the only SS7 MTP2 User protocols that are
   transported by this UAL.

   The SG provides an interworking of transport functions with the IP
   transport to transfer MTP2-User signalling messages with an
   Application Server (e.g., MGC) where the peer MTP2-User exists.

```
                 ******    SS7    ******      IP     *******
                 *SEP *-----------* SG *-------------* MGC *
                 ******           ******            *******


                 +----+                              +----+
                 |S7UP|                              |S7UP|
                 +----+                              +----+
                 |MTP3|                              |MTP3|
                 |    |           (NIF)              |    |
                 +----+       +----+----+           +----+
                 |    |       |    |M2UA|           |M2UA|
                 |    |       |    +----+           +----+
                 |MTP2|       |MTP2|SCTP|           |SCTP|
                 |    |       |    +----+           +----+
                 |    |       |    |IP  |           |IP  |
                 +----+       +---------+           +----+
```

         MGC - Media Gateway Controller
         SG   - Signalling Gateway
         SEP - SS7 Signalling Endpoint
         NIF - Nodal Interworking Function
         IP   - Internet Protocol
         SCTP - Stream Control Transmission Protocol

         Figure 8: SS7-IP Interworking using M2UA

The SCTP (and UDP/TCP) Registered User Port Number Assignment for
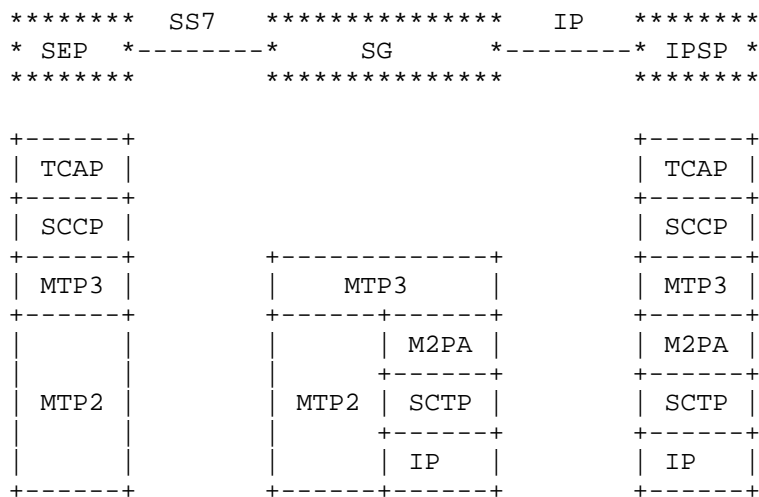M2UA is 2904.

The value assigned by IANA for the Payload Protocol Identifier in the
SCTP Payload Data chunk is "2".

4.2.1.2. M2PA (SS7 MTP2-User Peer-to-Peer Adaptation)

M2PA protocol is used between SS7 Signalling Points employing the MTP
Level 3 protocol. The SS7 Signalling Points may also use standard
SS7 links using the SS7 MTP Level 2 to provide transport of MTP Level
3 signalling messages.

Both configurations: communication of SS7 and IP with SG and
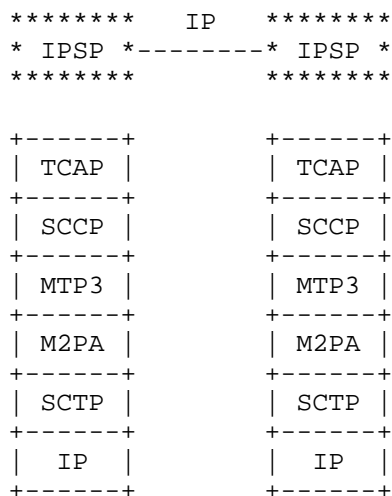communication between ISEPs are possible.

Connection of SS7 and IP nodes:

```
                 ********  SS7   **************   IP   ********
                 * SEP  *--------*     SG       *--------* IPSP *
                 ********        **************          ********


                 +------+                               +------+
                 | TCAP |                               | TCAP |
                 +------+                               +------+
                 | SCCP |                               | SCCP |
                 +------+        +-------------+        +------+
                 | MTP3 |        |    MTP3     |        | MTP3 |
                 +------+        +------+------+        +------+
                 |      |        |      | M2PA |        | M2PA |
                 |      |        |      +------+        +------+
                 | MTP2 |        | MTP2 | SCTP |        | SCTP |
                 |      |        |      +------+        +------+
                 |      |        |      | IP   |        | IP   |
                 +------+        +------+------+        +------+
```

                     SEP   - SS7 Signalling Endpoint

                 Figure 9: SS7-IP Interworking with M2PA

Communication between two IP nodes:

```
                        ********   IP   ********
                        * IPSP *--------* IPSP *
                        ********        ********


                        +------+        +------+
                        | TCAP |        | TCAP |
                        +------+        +------+
                        | SCCP |        | SCCP |
                        +------+        +------+
                        | MTP3 |        | MTP3 |
                        +------+        +------+
                        | M2PA |        | M2PA |
                        +------+        +------+
                        | SCTP |        | SCTP |
                        +------+        +------+
                        |  IP  |        |  IP  |
                        +------+        +------+


                   IP   - Internet Protocol
                   IPSP - IP Signalling Point
                   SCTP - Stream Control Transmission Protocol
```

Figure 10: Intra-IP Communication using M2PA

These figures are only an example. Other configurations are
possible. For example, IPSPs without traditional SS7 links could use
the protocol layers MTP3/M2PA/SCTP/IP to route SS7 messages in a
network with all IP links.

Another example is that two SGs could be connected over an IP network
to form an SG mated pair, similar to the way STPs are provisioned in
traditional SS7 networks.

The SCTP (and UDP/TCP) Registered User Port Number Assignment for
M2PA is 3565.

The value assigned by IANA for the Payload Protocol Identifier in the
SCTP Payload Data chunk is "5".

4.2.1.3. Main Differences between M2PA and M2UA

   o M2PA: IPSP processes MTP3/MTP2 primitives.
   o M2UA: MGC transports MTP3/MTP2 primitives between the SG's MTP2
      and the MGC's MTP3 (via the NIF) for processing.
   o M2PA: SG-IPSP connection is an SS7 link.
   o M2UA: SG-MGC connection is not an SS7 link. It is an extension of
      MTP to a remote entity.

4.2.2. M3UA (SS7 MTP3 User Adaptation) Layer

   UAL: M3UA (SS7 MTP3 User Adaptation)

   M3UA protocol supports the transport of any SS7 MTP3-User signalling
   such as TUP, ISUP, and SCCP over IP using the services of SCTP.

   Interconnection of SS7 and IP nodes:
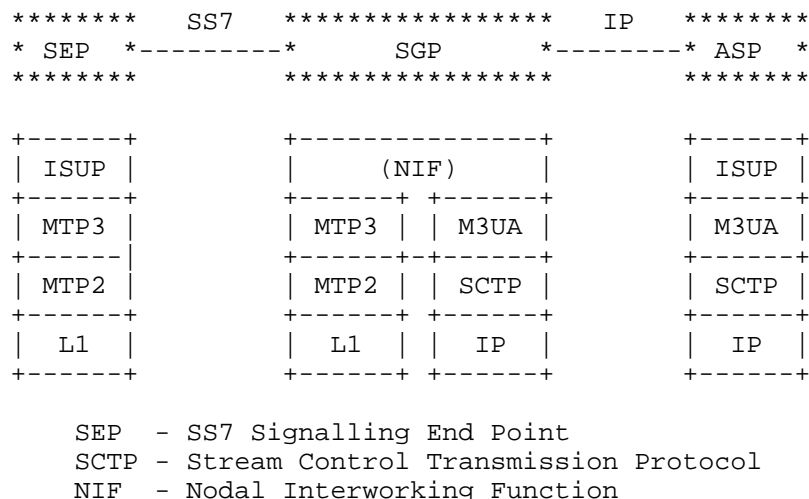
```
                ********   SS7   ****************   IP   ********
                * SEP  *---------*     SGP       *--------* ASP  *
                ********         ****************          ********


                +------+        +--------------+         +------+
                | ISUP |        |     (NIF)     |        | ISUP |
                +------+        +------+ +------+         +------+
                | MTP3 |        | MTP3 | | M3UA |         | M3UA |
                +------|        +------+-+------+         +------+
                | MTP2 |        | MTP2 | | SCTP |         | SCTP |
                +------+        +------+ +------+         +------+
                |  L1  |        |  L1  | |  IP  |         |  IP  |
                +------+        +------+ +------+         +------+


             SEP  - SS7 Signalling End Point
             SCTP - Stream Control Transmission Protocol
             NIF  - Nodal Interworking Function


          Figure 11: SS7-IP Interworking using M3UA
```

Communication between two IP nodes:

```
                        ********     IP    ********
                        * IPSP *----------* IPSP *
                        ********          ********


                        +------+          +------+
                        |SCCP- |          |SCCP- |
                        | User |          | User |
                        +------+          +------+
                        | SCCP |          | SCCP |
                        +------+          +------+
                        | M3UA |          | M3UA |
                        +------+          +------+
                        | SCTP |          | SCTP |
                        +------+          +------+
                        | IP   |          | IP   |
                        +------+          +------+
```
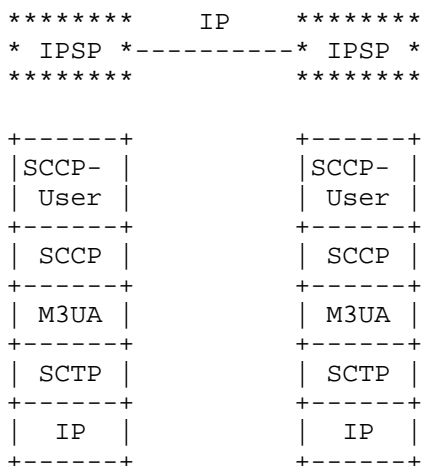
            Figure 12: Intra-IP Communication using M3UA

   M3UA uses a client-server architecture. It is recommended that the
   ISEP acts as the client and initiate the SCTP associations with the
   SG. The port reserved by IANA is 2905. This is the port upon which
   the SG should listen for possible client connections.

   The assigned payload protocol identifier for the SCTP DATA chunks is
   "3".

4.2.3. SUA (SS7 SCCP User Adaptation) Layer

   UAL: SUA (SS7 SCCP User Adaptation)

   SUA protocol supports the transport of any SS7 SCCP-User signalling
   such as MAP, INAP, SMS, BSSAP, or RANAP over IP using the services of
   SCTP. Each of the applications using SUA has its own set of timing
   requirements that can be found in its respective standards documents.

Possible configurations are showed in the pictures below.

- Interconnection of SS7 and IP:
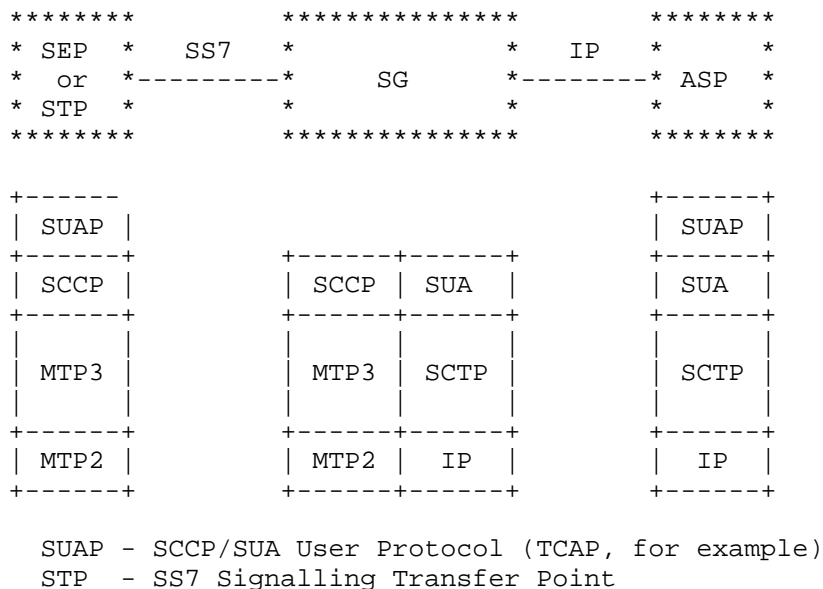
```
            ********        ***************        ********
            * SEP  *   SS7  *             * IP  *        *
            *  or  *--------*     SG      *-------* ASP  *
            * STP  *        *             *     *        *
            ********        ***************        ********


            +------                                +------+
            | SUAP |                                | SUAP |
            +------+        +------+------+         +------+
            | SCCP |        | SCCP | SUA  |         | SUA  |
            +------+        +------+------+         +------+
            |      |        |      |      |         |      |
            | MTP3 |        | MTP3 | SCTP |         | SCTP |
            |      |        |      |      |         |      |
            +------+        +------+------+         +------+
            | MTP2 |        | MTP2 | IP   |         | IP   |
            +------+        +------+------+         +------+


              SUAP - SCCP/SUA User Protocol (TCAP, for example)
              STP  - SS7 Signalling Transfer Point

          Figure 13: SS7-IP Interworking using SUA
```

- IP Node to IP Node communication:
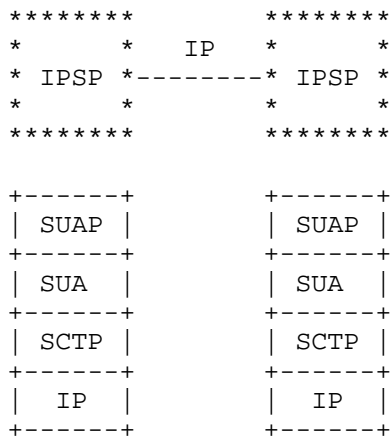
```
            ********        ********
            *      * IP  *        *
            * IPSP *--------* IPSP *
            *      *        *      *
            ********        ********


            +------+        +------+
            | SUAP |        | SUAP |
            +------+        +------+
            | SUA  |        | SUA  |
            +------+        +------+
            | SCTP |        | SCTP |
            +------+        +------+
            | IP   |        | IP   |
            +------+        +------+


          Figure 14: Intra-IP Communication using SUA
```

IANA has registered SCTP Port Number 14001 for SUA. It is
recommended that SGs use this SCTP port number for listening for new
connections. The payload protocol identifier for the SCTP DATA
chunks is "4".

5. Security Considerations

UALs are designated to carry signalling messages for telephony
services. As such, UALs must involve the security needs of several
parties: the end users of the services, the network providers, and
the applications involved. Additional requirements may come from
local regulation. Although some security needs overlap, any security
solution should fulfill all the different parties' needs. See
specific Security Considerations in each UAL Technical specification
for details (for general security principles of SIGTRAN, see
[RFC3788]).

SCTP only tries to increase the availability of a network. SCTP does
not contain any protocol mechanisms directly related to communication
security, i.e., user message authentication, integrity, or
confidentiality functions. For such features, SCTP depends on
security protocols. In the field of system security, SCTP includes
mechanisms for reducing the risk of blind denial-of-service attacks
as described in Section 11 of [RFC2960].

This document does not add any new components to the protocols
included in the discussion. For secure use of the SIGTRAN protocols,
readers should go through the "Security Considerations for SIGTRAN
Protocols" [RFC3788]). According to that document, the use of the
IPsec is the main requirement to secure SIGTRAN protocols in the
Internet, but Transport Layer Security (TLS) is also considered a
perfectly valid option for use in certain scenarios (see [RFC3436]
for more information on using TLS with SCTP). Recommendations of
usage are also included.

6. Informative References

   [ALLMAN99] Allman, M. and V. Paxson, "On Estimating End-to-End
               Network Path Properties", Proc. SIGCOMM'99, 1999.

   [RFC2960]   Stewart, R., Xie, Q., Morneault, K., Sharp, C.,
               Schwarzbauer, H., Taylor, T., Rytina, I., Kalla, M.,
               Zhang, L., and V. Paxson, "Stream Control Transmission
               Protocol", RFC 2960, October 2000.

   [RFC3257]   Coene, L., "Stream Control Transmission Protocol
               Applicability Statement", RFC 3257, April 2002.

   [RFC2719]   Ong, L., Rytina, I., Garcia, M., Schwarzbauer, H., Coene,
               L., Lin, H., Juhasz, I., Holdrege, M., and C. Sharp,
               "Framework Architecture for Signaling Transport", RFC
               2719, October 1999.

   [RFC3057]   Morneault, K., Rengasami, S., Kalla, M., and G.
               Sidebottom, "ISDN Q.921-User Adaptation Layer", RFC 3057,
               February 2001.

   [RFC3331]   Morneault, K., Dantu, R., Sidebottom, G., Bidulock, B.,
               and J. Heitz, "Signaling System 7 (SS7) Message Transfer
               Part 2 (MTP2) - User Adaptation Layer", RFC 3331,
               September 2002.

   [RFC3332]   Sidebottom, G., Morneault, K., and J. Pastor-Balbas,
               "Signaling System 7 (SS7) Message Transfer Part 3 (MTP3)
               - User Adaptation Layer (M3UA)", RFC 3332, September
               2002.

   [RFC3436]   Jungmaier, A., Rescorla, E., and M. Tuexen, "Transport
               Layer Security over Stream Control Transmission
               Protocol", RFC 3436, December 2002.

   [RFC3868]   Loughney, J., Sidebottom, G., Coene, L., Verwimp, G.,
               Keller, J., and B. Bidulock, "Signalling Connection
               Control Part User Adaptation Layer (SUA)", RFC 3868,
               October 2004.

   [RFC4165]   George, T., Dantu, R., Kalla, M., Schwarzbauer, H.J.,
               Sidebottom, G., Morneault, K.,"SS7 MTP2-User Peer-to-Peer
               Adaptation Layer", RFC 4165, September 2005.

   [RFC3807]   Weilandt, E., Khanchandani, N., and S. Rao, "V5.2-User
               Adaptation Layer (V5UA)", RFC 3807, June 2004.

   [RFC4129]   Mukundan, R., Morneault, K., and N. Mangalpally, "Digital
               Private Network Signaling System (DPNSS)/Digital Access
               Signaling System 2 (DASS 2) Extensions to the IUA
               Protocol", RFC 4129, September 2005.

   [RFC3788]   Loughney, J., Tuexen, M., and J. Pastor-Balbas, "Security
               Considerations for Signaling Transport (SIGTRAN)
               Protocols", RFC 3788, June 2004.

Authors' Addresses

   Lode Coene
   Siemens
   Atealaan 34
   Herentals B-2200
   Belgium

   Phone: +32-14-252081
   EMail: lode.coene@siemens.com

   Javier Pastor-Balbas
   Ericsson
   Via de los Poblados 13
   Madrid 28033
   Spain

   Phone: +34 91 339 1397
   EMail: J.Javier.Pastor@ericsson.com

Full Copyright Statement

Intellectual Property

Acknowledgement