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               Framework Architecture for Signaling Transport

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Abstract

   This document defines an architecture framework and functional
   requirements for transport of signaling information over IP. The
   framework describes relationships between functional and physical
   entities exchanging signaling information, such as Signaling Gateways
   and Media Gateway Controllers. It identifies interfaces where
   signaling transport may be used and the functional and performance
   requirements that apply from existing Switched Circuit Network (SCN)
   signaling protocols.

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1. Introduction

1.1 Overview

    This document defines an architecture framework for transport of
    message-based signaling protocols over IP networks. The scope of
    this work includes definition of encapsulation methods, end-to-end
    protocol mechanisms and use of existing IP capabilities to support
    the functional and performance requirements for signaling transport.

    The framework portion describes the relationships between functional
    and physical entities used in signaling transport, including the
    framework for control of Media Gateways, and other scenarios where
    signaling transport may be required.

The requirements portion describes functional and performance
requirements for signaling transport such as flow control, in-
sequence delivery and other functions that may be required for
specific SCN signaling protocols.

1.2 Terminology

The following are general terms are used in this document:

Backhaul:

Backhaul refers to the transport of signaling from the point of
interface for the associated data stream (i.e., SG function in the
MGU) back to the point of call processing (i.e., the MGCU), if this
is not local.

Signaling Transport (SIG):

SIG refers to a protocol stack for transport of SCN signaling
protocols over an IP network. It will support standard primitives to
interface with an unmodified SCN signaling application being
transported, and supplements a standard IP transport protocol
underneath with functions designed to meet transport requirements for
SCN signaling.

Switched Circuit Network (SCN):

The term SCN is used to refer to a network that carries traffic
within channelized bearers of pre-defined sizes. Examples include
Public Switched Telephone Networks (PSTNs) and Public Land Mobile
Networks (PLMNs). Examples of signaling protocols used in SCN
include Q.931, SS7 MTP Level 3 and SS7 Application/User parts.

The following are terms for functional entities relating to signaling
transport in a distributed gateway model.

Media Gateway (MG):

A MG terminates SCN media streams, packetizes the media data,, if it
is not already packetized, and delivers packetized traffic to the
packet network. It performs these functions in reverse order for
media streams flowing from the packet network to the SCN.

Media Gateway Controller (MGC):

An MGC handles the registration and management of resources at the MG. The MGC may have the ability to authorize resource usage based on local policy. For signaling transport purposes, the MGC serves as a possible termination and origination point for SCN application protocols, such as SS7 ISDN User Part and Q.931/DSS1.

Signaling Gateway (SG):

An SG is a signaling agent that receives/sends SCN native signaling at the edge of the IP network. The SG function may relay, translate or terminate SS7 signaling in an SS7-Internet Gateway. The SG function may also be co-resident with the MG function to process SCN signaling associated with line or trunk terminations controlled by the MG (e.g., signaling backhaul).

The following are terms for physical entities relating to signaling transport in a distributed gateway model:

Media Gateway Unit (MGU)

An MG-Unit is a physical entity that contains the MG function. It may contain other functions, esp. an SG function for handling facility-associated signaling.

Media Gateway Control Unit (MGCU)

An MGC-Unit is a physical entity containing the MGC function.

Signaling Gateway Unit (SGU)

An SG-Unit is a physical entity containing the SG function.

Signaling End Point (SEP):

This is a node in an SS7 network that originates or terminates signaling messages. One example is a central office switch.

Signal Transfer Point (STP):

This is a node in an SS7 network that routes signaling messages based on their destination point code in the SS7 network.

1.3 Scope

   Signaling transport provides transparent transport of message-based
   signaling protocols over IP networks.   The scope of this work
   includes definition of encapsulation methods, end-to-end protocol
   mechanisms and use of IP capabilities to support the functional and
   performance requirements for signaling.

   Signaling transport shall be used for transporting SCN signaling
   between a Signaling Gateway Unit and Media Gateway Controller Unit.
   Signaling transport may also be used for transport of message-based
   signaling between a Media Gateway Unit and Media Gateway Controller
   Unit, between dispersed Media Gateway Controller Units, and between
   two Signaling Gateway Units connecting signaling endpoints or signal
   transfer points in the SCN.

   Signaling transport will be defined in such a way as to support
   encapsulation and carriage of a variety of SCN protocols. It is
   defined in such a way as to be independent of any SCN protocol
   translation functions taking place at the endpoints of the signaling
   transport, since its function is limited to the transport of the SCN
   protocol.

   Since the function being provided is transparent transport, the
   following areas are considered outside the scope of the signaling
   transport work:

   - definition of the SCN protocols themselves.
   - signaling interworking such as conversion from Channel Associated
      Signaling (CAS) to message signaling protocols.
   - specification of the functions taking place within the SGU or MGU
   - in particular, this work does not address whether the SGU provides
      mediation/interworking, as this is transparent to the transport
      function.
   - similarly, some management and addressing functions taking place
      within the SGU or MGU are also considered out of scope, such as
      determination of the destination IP address for signaling, or
      specific procedures for assessing the performance of the transport
      session (i.e., testing and proving functions).

2. Signaling Transport Architecture

2.1 Gateway Component Functions

   Figure 1 defines a commonly defined functional model that separates
   out the functions of SG, MGC and MG. This model may be implemented
   in a number of ways, with functions implemented in separate devices
   or combined in single physical units.

Where physical separation exists between functional entities,
Signaling Transport can be applied to ensure that SCN signaling
information is transported between entities with the required
functionality and performance.

```
           +---------------+                      +--------------+
           |               |                      |              |
    SCN<-------->[SG]  <--+---------O------------+--> [SG]  <------> SCN
    signal |        |      |                      |      |      |    signal
           +-------|-------+                      +-----|--------+
           Signaling|gateway                      Signaling|gateway (opt)
                  O                                       O
                  |                                       |
           +-------|-------+                      +-----|--------+
           |       |       |                      |     |        |
           |    [MGC]  <--+--------O-------------+--> [MGC]       |
           |       |       |                      |     |        |
           |       |       |                      |     |        |
           +-------|-------+                      +-----|--------+
           Gateway | controller                   Gateway | controller (opt)
                  O                                       O
                  |                                       |
           +-------|-------+                      +-----|--------+
    Media  |       |       |                      |     |        | Media
    <------+---->[MG]  <---+-----RTP stream-------+-> [MG]  <----+-------->
    stream|                |                      |              | stream
           +---------------+                      +--------------+
           Media gateway                          Media gateway
```
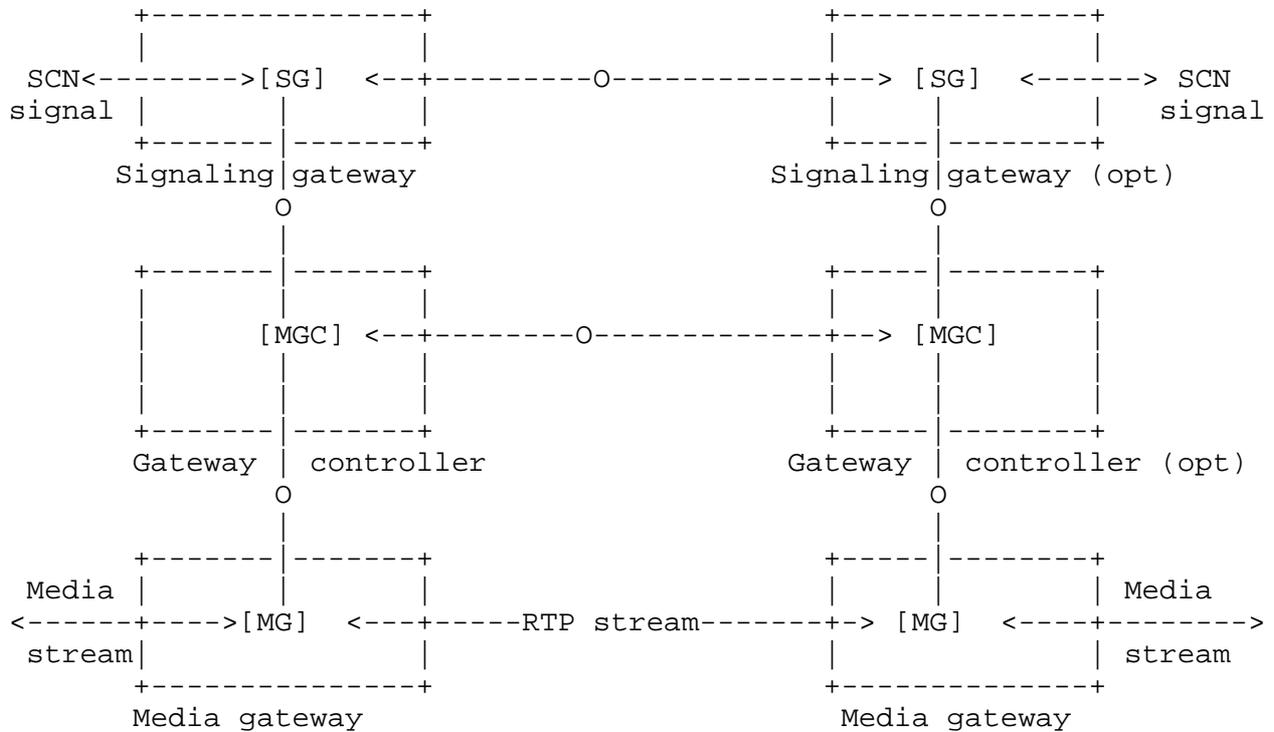
Figure 1: Sigtran Functional Model

As discussed above, the interfaces pertaining to signaling transport
include SG to MGC, SG to SG. Signaling transport may potentially be
applied to the MGC to MGC or MG to MGC interfaces as well, depending
on requirements for transport of the associated signaling protocol.

2.2 SS7 Interworking for Connection Control

Figure 2 below shows some example implementations of these functions
in physical entities as used for interworking of SS7 and IP networks
for Voice over IP, Voice over ATM, Network Access Servers, etc. No
recommendation is made as to functional distribution and many other
examples are possible but are not shown to be concise. The use of
signaling transport is independent of the implementation.

For interworking with SS7-controlled SCN networks, the SG terminates
the SS7 link and transfers the signaling information to the MGC using
signaling transport. The MG terminates the interswitch trunk and
controls the trunk based on the control signaling it receives from
the MGC. As shown below in case (a), the SG, MGC and MG may be
implemented in separate physical units, or as in case (b), the MGC
and MG may be implemented in a single physical unit.

In alternative case (c), a facility-associated SS7 link is terminated
by the same device (i.e., the MGU) that terminates the interswitch
trunk. In this case, the SG function is co-located with the MG
function, as shown below, and signaling transport is used to
"backhaul" control signaling to the MGCU.

Note: SS7 links may also be terminated directly on the MGCU by
cross-connecting at the physical level before or at the MGU.

```
        SGU
       +--------+
SS7<------>[SG]  |
(ISUP) |   |    |
       +---|----+
        ST |                  SGU                      MGCU
       +---|----+          +--------+              +--------+
       | [MGC]  |          SS7---->[SG]  |          |  [MGC]  |
       |   |    |          |   |    |              |  | |  |
       +---|----+          +---|----+              +--|-|---+
       MGCU|                 ST |                    | |
           |                   |                  ST | |
    Media +---|----+    Media +---|----+          +--|-|---+
     ------->[MG]  |     ----->[MG/MGC]|   SS7 link-->[SG]|    |
    stream |     |    stream |     |      Media------> [MG] |
       +--------+          +--------+      stream   +--------+
        MGU                  MGU                      MGU

        (a)                  (b)                      (c)
```
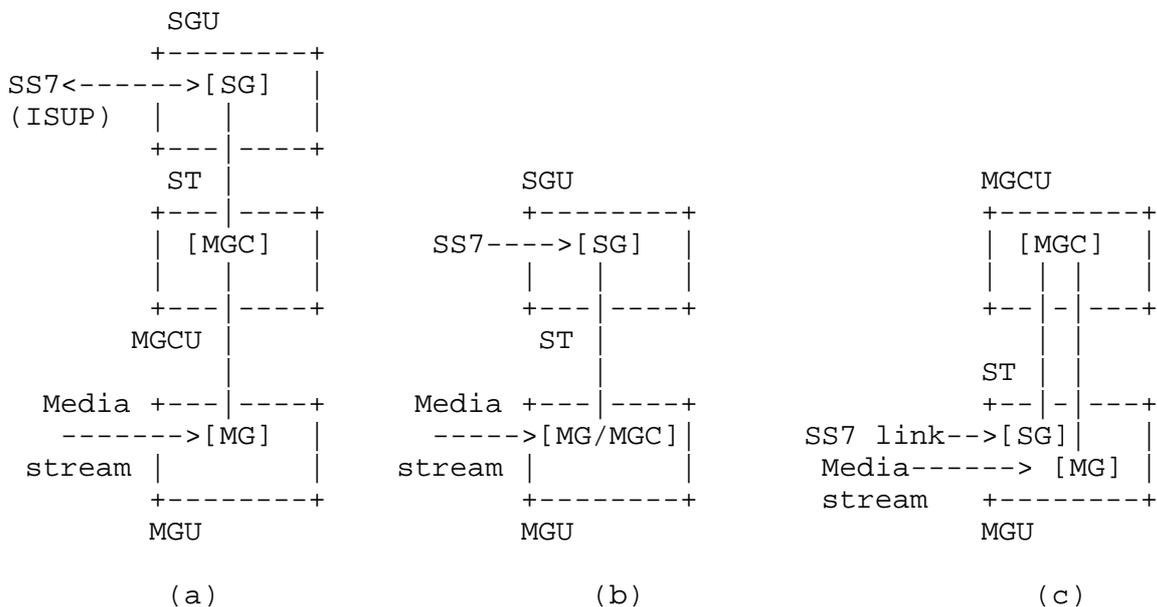
Notes: ST = Signaling Transport used to carry SCN signaling

Figure 2: Example Implementations

   In some implementations, the function of the SG may be divided into
   multiple physical entities to support scaling, signaling network
   management and addressing concerns. Thus, Signaling Transport can be
   used between SGs as well as from SG to MGC. This is shown in Figure 3
   below.

```
        SGU                                       MGCU
        +---------+                        +---------+
        |         |            ST          |         |
        |  [SG2]--------------------------->[MGC]    |
        |  ^ ^    |                         |         |
        +---|-|---+                         +---------+
            | |
            | |                  ST
        ST| +-----------------------------+
          |                               |
          |                               |
    SS7 +---|----------+          SS7  +----|---------+
 ----------> [SG1]     |        ----------> [SG1]     |
   media    |          |          media    |          |
 ------------------->[MG] |        ------------------->[MG] |
   stream   +-------------+        stream   +-------------+
          MGU                             MGU
```
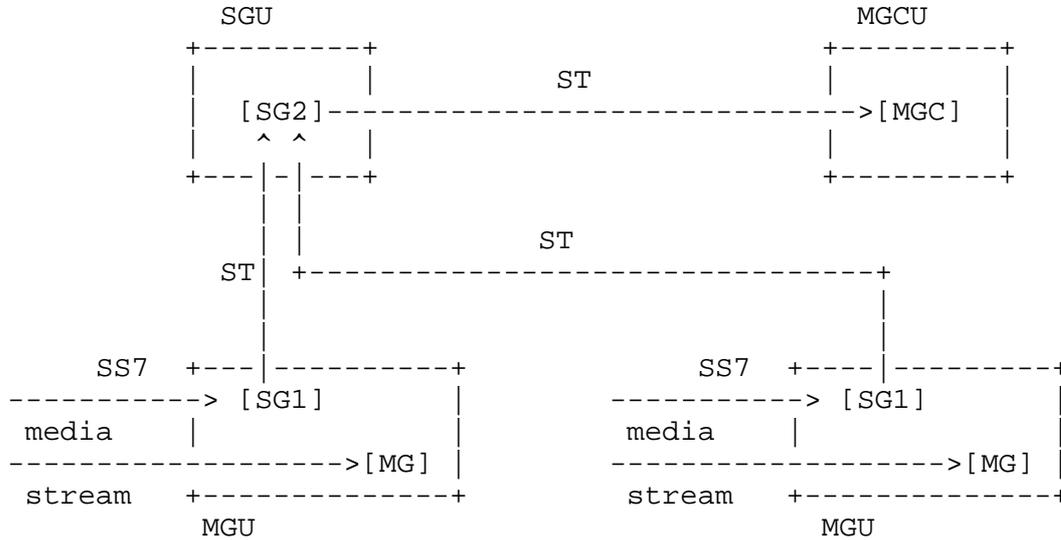
                     Figure 3: Multiple SG Case

   In this configuration, there may be more than one MGU handling
   facility associated signaling (i.e. more than one containing it's own
   SG function), and only a single SGU. It will therefore be possible to
   transport one SS7 layer between SG1 and SG2, and another SS7 layer
   between SG2 and MGC. For example, SG1 could transport MTP3 to SG2,
   and SG2 could transport ISUP to MGC.

2.3 ISDN Interworking for Connection Control

   In ISDN access signaling, the signaling channel is carried along with
   data channels, so that the SG function for handling Q.931 signaling
   is co-located with the MG function for handling the data stream.
   Where Q.931 is then transported to the MGC for call processing,
   signaling transport would be used between the SG function and MGC.
   This is shown in Figure 3 below.

```
                       MGCU
                       +-------------+
                       |    [MGC]    |
                       |    | |      |
                       +-----|-|-----+
                             | |
                             | O device control
                             | |
                   Q.931/ST O |
                             | |
                       +-----|-|-----+
                       |     | |     |
                   Q.931---->[SG]|   |
                   signals|      |   |
                       |      |   |
                   Media---->[MG]   |
                   stream  |        |
                       +-------------+
                       MGU
```
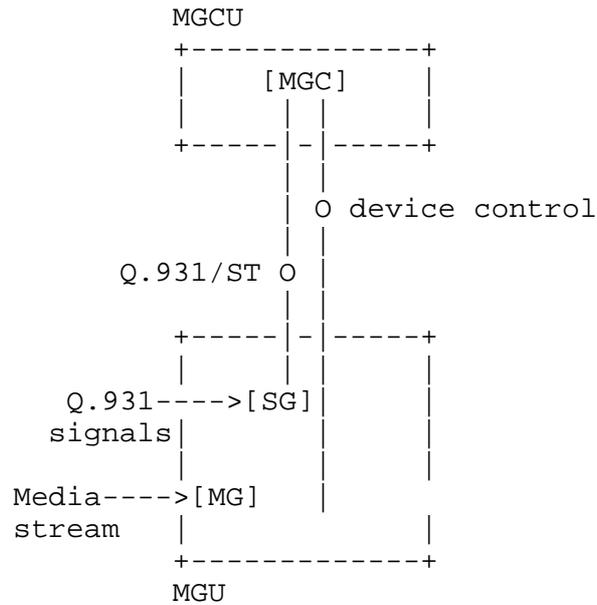
                Figure 4: Q.931 transport model

2.4 Architecture for Database Access

   Transaction Capabilities (TCAP) is the application part within SS7
   that is used for non-circuit-related signaling.

   TCAP signaling within IP networks may be used for cross-access
   between entities in the SS7 domain and the IP domain, such as, for
   example:

   - access from an SS7 network to a Service Control Point (SCP) in IP.
   - access from an SS7 network to an MGC.
   - access from an MGC to an SS7 network element.
   - access from an IP SCP to an SS7 network element.

   A basic functional model for TCAP over IP is shown in Figure 5.

```
                            +--------------+
                            |  IP SCP      |
                            +--|----|------+
                               |    |
           SGU                 |    |                      SGU
         +--------------+      |    |      +--------------+
         |              |      |    |      |              |
SS7<--------->[SG] ----------+  |    |      |  [SG]<---------> SS7
(TCAP)   |              |      |    |      |              |
         +------|-------+      |    |      +------|-------+
                |                   |             |
                O    +-----------+  |             O
        MGCU    |    |           |  |       MGCU  |
         +------|----|--+        |  |     +-----|--------+
         |      |    |  |        |  |     |     |        |
         |    [MGC]  |  |        |  |     |   [MGC]      |
         |      |    |  |        |  |     |     |        |
         +------|-------+        |  |     +-----|--------+
                |                   |           |
         +------|-------+        +-----|------+
 Media   |      |       |        |     |      | Media
<------+---->[MG]  <---+--RTP stream---+--> [MG]  <-+-------->
 stream|       |        |              |     |      | stream
         +--------------+        +-----------+
           MGU                    MGU
```
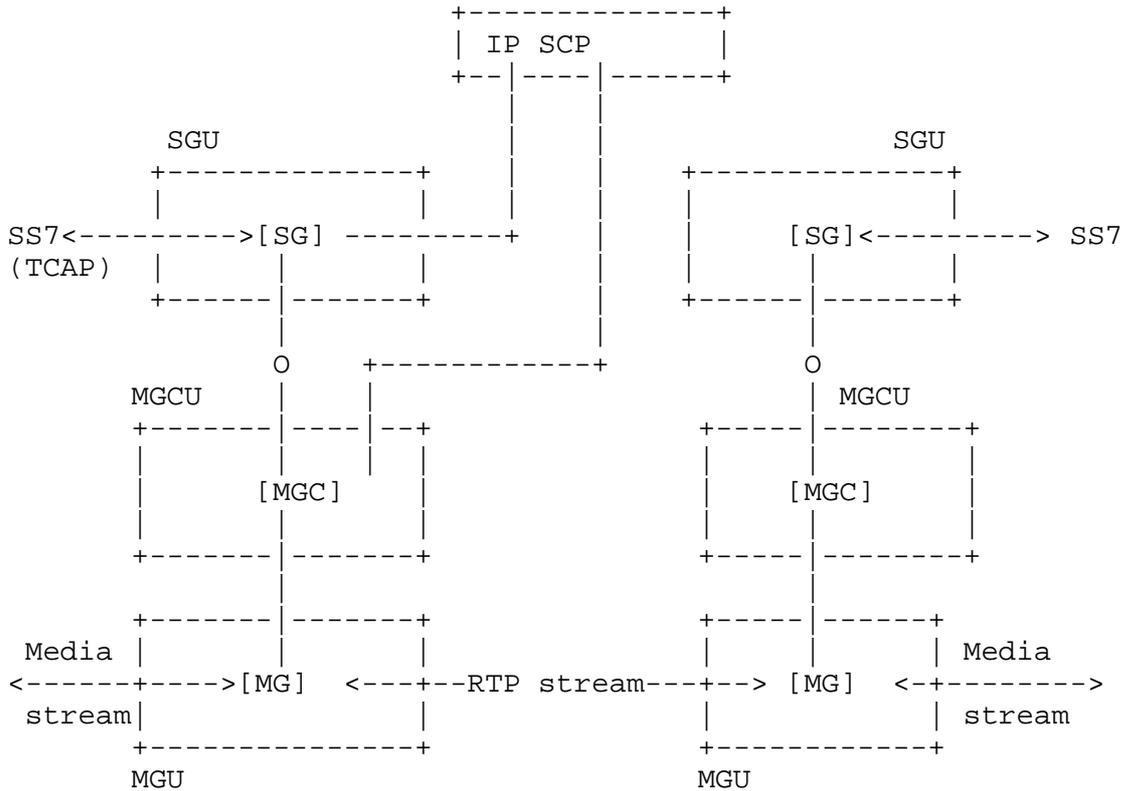
Figure 5: TCAP Signaling over IP

3. Protocol Architecture

   This section provides a series of examples of protocol architecture
   for the use of Signaling Transport (SIG).

3.1 Signaling Transport Components

   Signaling Transport in the protocol architecture figures below is
   assumed to consist of three components (see Figure 6):

   1) an adaptation sub-layer that supports specific primitives, e.g.,
      management indications, required by a particular SCN signaling
      application protocol.
   2) a Common Signaling Transport Protocol that supports a common set
      of reliable transport functions for signaling transport.
   3) a standard, unmodified IP transport protocol.

```
        +-- +------------------------------+
        |   |      SCN adaptation module   |
        |   +------------------------------+
        |                  |
      S |   +------------------------------+
      I |   | Common Signaling Transport   |
      G |   +------------------------------+
        |                  |
        |   +------------------------------+
        |   |      standard IP transport   |
        +-- +------------------------------+
```
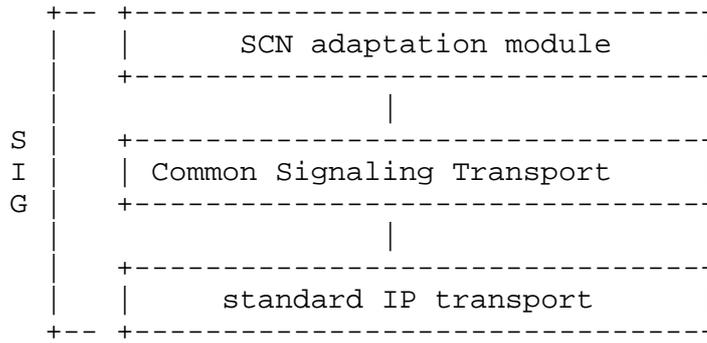
Figure 6: Signaling Transport Components

3.2. SS7 access for Media Gateway Control

   This section provides a protocol architecture for signaling transport
   supporting SS7 access for Media Gateway Control.
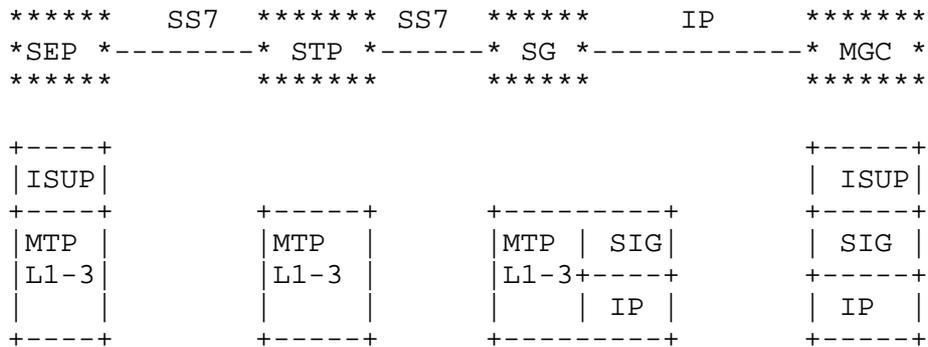
```
        ******    SS7  ******* SS7  ******       IP    *******
        *SEP *--------* STP *------* SG *------------* MGC *
        ******         *******      ******           *******


        +----+                                       +-----+
        |ISUP|                                        | ISUP|
        +----+         +-----+      +---------+       +-----+
        |MTP |         |MTP  |      |MTP | SIG|       | SIG |
        |L1-3|         |L1-3 |      |L1-3+----+       +-----+
        |    |         |     |      |    | IP |       | IP  |
        +----+         +-----+      +---------+       +-----+


        STP - Signal Transfer Point    SEP - Signaling End Point
        SG - Signaling Gateway         SIG - Signaling Transport
        MGC - Media Gateway Controller
```

Figure 7: SS7 Access to MGC

3.3. Q.931 Access to MGC

   This section provides a protocol architecture for signaling transport
   supporting ISDN point-to-point access (Q.931) for Media Gateway
   Control.
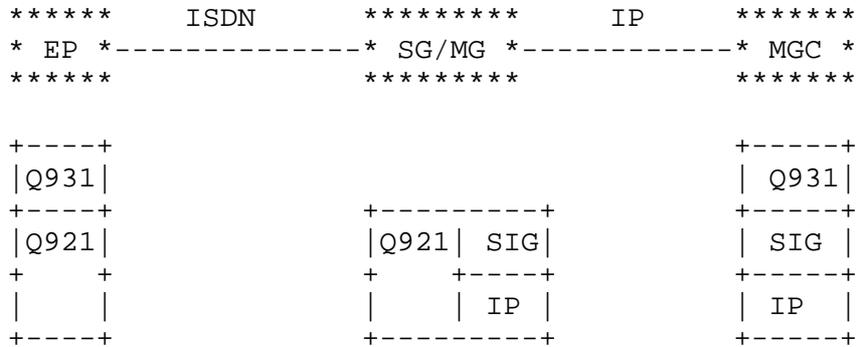
```
              ******    ISDN     ********    IP     *******
              * EP *-------------* SG/MG *-----------* MGC *
              ******             ********            *******

              +----+                                 +-----+
              |Q931|                                 | Q931|
              +----+             +---------+         +-----+
              |Q921|             |Q921| SIG|         | SIG |
              +    +             +    +----+         +-----+
              |    |             |    | IP |         | IP  |
              +----+             +---------+         +-----+

              MG/SG - Media Gateway with SG function for backhaul
              EP - ISDN End Point
```

                      Figure 8: ISDN Access

3.4. SS7 Access to IP/SCP

   This section provides a protocol architecture for database access,
   for example providing signaling between two IN nodes or two mobile
   network nodes. There are a number of scenarios for the protocol
   stacks and the functionality contained in the SIG, depending on the
   SS7 application.

   In the diagrams, SS7 Application Part (S7AP) is used for generality
   to cover all Application Parts (e.g. MAP, IS-41, INAP, etc).
   Depending on the protocol being transported, S7AP may or may not
   include TCAP. The interface to the SS7 layer below S7AP can be either
   the TC-user interface or the SCCP-user interface.

   Figure 9a shows the scenario where SCCP is the signaling protocol
   being transported between the SG and an IP Signaling Endpoint (ISEP),
   that is, an IP destination supporting some SS7 application protocols.

```
      ******   SS7  ******* SS7  ******       IP      *******
      *SEP *--------* STP *------* SG *-------------* ISEP*
      ******        *******       ******           *******


      +-----+                                      +-----+
      |S7AP |                                      |S7AP |
      +-----+                                      +-----+
      |SCCP |                                      |SCCP |
      +-----+        +-----+       +---------+     +-----+
      |MTP  |        |MTP  |       |MTP |SIG |     |SIG  |
      +     +        +     +       +    +----+     +-----+
      |     |        |     |       |    | IP |     |IP   |
      +-----+        +-----+       +---------+     +-----+
```
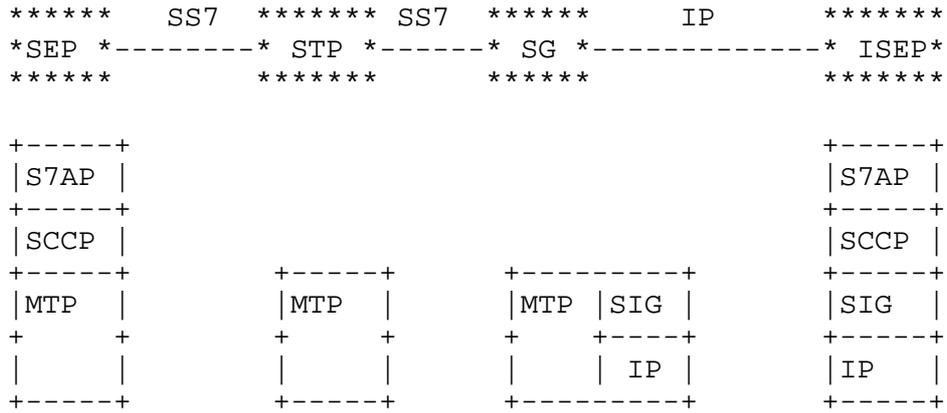
        Figure 9a: SS7 Access to IP node - SCCP being transported

    Figure 9b shows the scenario where S7AP is the signaling protocol
    being transported between SG and ISEP. Depending on the protocol
    being transported, S7AP may or may not include TCAP, which implies
    that SIG must be able to support both the TC-user and the SCCP-user
    interfaces.

```
      ******   SS7  ******* SS7  ******       IP      *******
      *SEP *--------* STP *------* SG *-------------* ISEP*
      ******        *******       ******           *******


      +-----+                                      +-----+
      |S7AP |                                      |S7AP |
      +-----+                       +----+----+    +-----+
      |SCCP |                       |SCCP|    |    |     |
      +-----+        +-----+        +----|SIG |    |SIG  |
      |MTP  |        |MTP  |        |MTP |    |    |     |
      +     +        +     +        +    +----+    +-----+
      |     |        |     |        |    |IP  |    |IP   |
      +-----+        +-----+        +---------+    +-----+
```
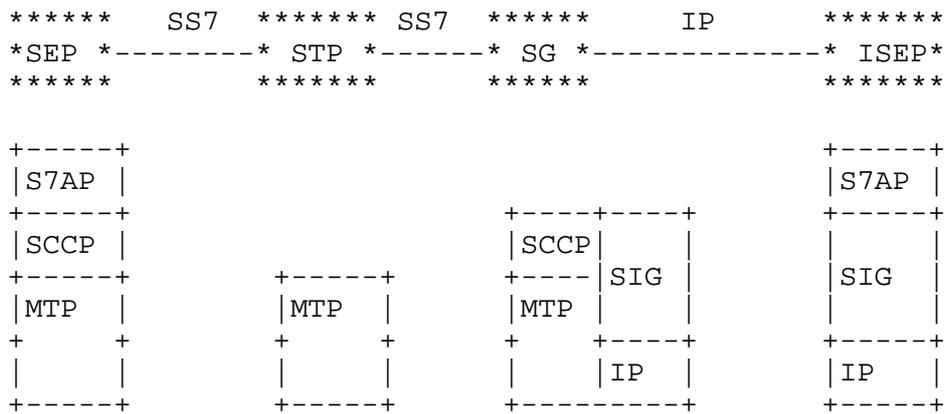
        Figure 9b: SS7 Access to IP node - S7AP being transported

3.5. SG to SG

   This section identifies a protocol architecture for support of
   signaling between two endpoints in an SCN signaling network, using
   signaling transport directly between two SGs.

   The following figure describes protocol architecture for a scenario
   with two SGs providing different levels of function for interworking
   of SS7 and IP. This corresponds to the scenario given in Figure 3.

   The SS7 User Part (S7UP) shown is an SS7 protocol using MTP directly
   for transport within the SS7 network, for example, ISUP.

   In this scenario, there are two different usage cases of SIG, one
   which transports MTP3 signaling, the other which transports ISUP
   signaling.
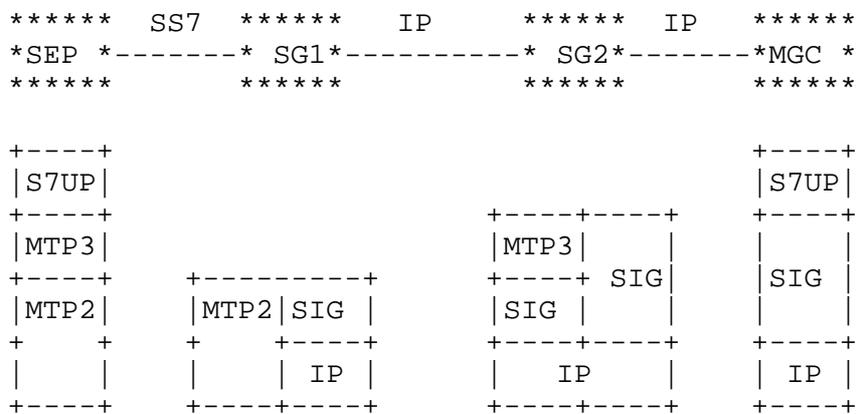
```
           ******  SS7  ******   IP       ******  IP   ******
           *SEP *-------* SG1*----------* SG2*-------*MGC *
           ******        ******           ******        ******


           +----+                                         +----+
           |S7UP|                                         |S7UP|
           +----+                        +----+----+      +----+
           |MTP3|                         |MTP3|    |    |    |
           +----+     +---------+        +----+ SIG|    |SIG |
           |MTP2|     |MTP2|SIG |        |SIG |    |    |    |
           +    +     +    +----+        +----+----+      +----+
           |    |     |    | IP |        |   IP    |    | IP |
           +----+     +----+----+        +----+----+      +----+

           S7UP - SS7 User Part
```

                  Figure 10: SG to SG Case 1

   The following figure describes a more generic use of SS7-IP
   interworking for transport of SS7 upper layer signaling across an IP
   network, where the endpoints are both SS7 SEPs.

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

          +----+                                      +-----+
          |S7UP|                                      | S7UP|
          +----+                                      +-----+
          |MTP3|                                      | MTP3|
          +----+        +---------+     +---------+    +-----+
          |MTP2|        |MTP2| SIG|     |SIG |MTP2|    | MTP2|
          +    +        +    +----+     +----+    +    +    +
          |    |        |    | IP |     | IP |    |    |    |
          +----+        +----+----+     +----+----+    +-----+
```
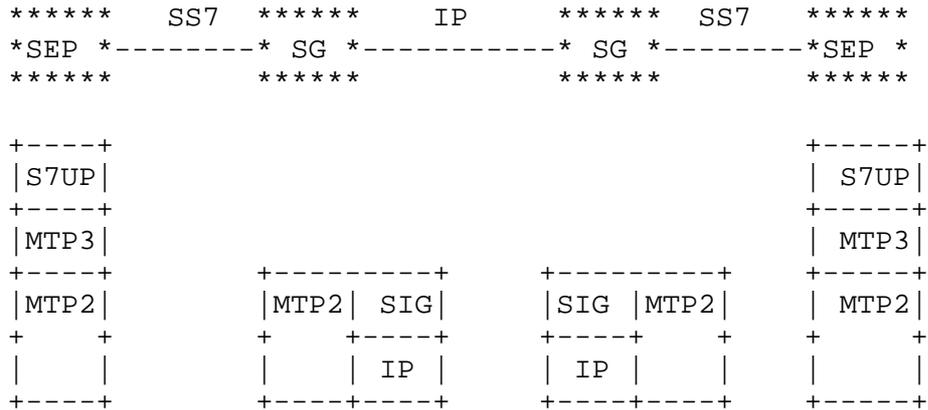
                     Figure 11: SG to SG Case 2

4. Functional Requirements

4.1 Transport of SCN Signaling Protocols

   Signaling transport provides for the transport of native SCN protocol
   messages over a packet switched network.

   Signaling transport shall:

   1) Transport of a variety of SCN protocol types, such as the
   application and user parts of SS7 (including MTP Level 3, ISUP, SCCP,
   TCAP, MAP, INAP, IS-41, etc.) and layer 3 of the DSS1/PSS1 protocols
   (i.e. Q.931 and QSIG).

   2) Provide a means to identify the particular SCN protocol being
   transported.

   3) Provide a common base protocol defining header formats, security
   extensions and procedures for signaling transport, and support
   extensions as necessary to add individual SCN protocols if and when
   required.

   4) In conjunction with the underlying network protocol (IP), provide
   the relevant functionality as defined by the appropriate SCN lower
   layer.

   Relevant functionality may include (according to the protocol being
   transported):

   - flow control
   - in sequence delivery of signaling messages within a control stream

- logical identification of the entities on which the signaling
  messages originate or terminate
- logical identification of the physical interface controlled by the
  signaling message
- error detection
- recovery from failure of components in the transit path
- retransmission and other error correcting methods
- detection of unavailability of peer entities.

For example:

- if the native SCN protocol is ISUP or SCCP, the relevant
  functionality provided by MTP2/3 shall be provided.
- if the native SCN protocol is TCAP, the relevant functionality
  provided by SCCP connectionless classes and MTP 2/3 shall be
  supported.
- if the native SCN protocol is Q.931, the relevant functionality
  provided by Q.921 shall be supported.
- if the native SCN protocol is MTP3, the relevant functionality of
  MTP2 shall be supported.

5) Support the ability to multiplex several higher layer SCN sessions
on one underlying signaling transport session. This allows, for
example, several DSS1 D-Channel sessions to be carried in one
signaling transport session.

In general, in-sequence delivery is required for signaling messages
within a single control stream, but is not necessarily required for
messages that belong to different control streams. The protocol
should if possible take advantage of this property to avoid blocking
delivery of messages in one control stream due to sequence error
within another control stream. The protocol should also allow the SG
to send different control streams to different destination ports if
desired.

6) Be able to transport complete messages of greater length than the
underlying SCN segmentation/reassembly limitations. For example,
signaling transport should not be constrained by the length
limitations defined for SS7 lower layer protocol (e.g. 272 bytes in
the case of narrowband SS7) but should be capable of carrying longer
messages without requiring segmentation.

7) Allow for a range of suitably robust security schemes to protect
signaling information being carried across networks. For example,
signaling transport shall be able to operate over proxyable sessions,
and be able to be transported through firewalls.

8) Provide for congestion avoidance on the Internet, by supporting appropriate controls on signaling traffic generation (including signaling generated in SCN) and reaction to network congestion.

4.2 Performance of SCN Signaling Protocols

This section provides basic values regarding performance requirements of key SCN protocols to be transported. Currently only message-based SCN protocols are considered. Failure to meet these requirements is likely to result in adverse and undesirable signaling and call behavior.

4.2.1 SS7 MTP requirements

The performance requirements below have been specified for transport of MTP Level 3 network management messages. The requirements given here are only applicable if all MTP Level 3 messages are to be transported over the IP network.

- Message Delay
   - MTP Level 3 peer-to-peer procedures require response within 500 to 1200 ms. This value includes round trip time and processing at the remote end.
     Failure to meet this limitation will result in the initiation of error procedures for specific timers, e.g., timer T4 of ITU-T Recommendation Q.704.

4.2.2 SS7 MTP Level 3 requirements

The performance requirements below have been specified for transport of MTP Level 3 user part messages as part of ITU-T SS7 Recommendations [SS7].

- Message Loss
   - no more than 1 in 10E+7 messages will be lost due to transport failure

- Sequence Error
   - no more than 1 in 10E+10 messages will be delivered out-of-sequence (including duplicated messages) due to transport failure

- Message Errors
   - no more than 1 in 10E+10 messages will contain an error that is undetected by the transport protocol (requirement is 10E+9 for ANSI specifications)

- Availability
  - availability of any signaling route set is 99.9998% or better,
    i.e., downtime 10 min/year or less. A signaling route set is
    the complete set of allowed signaling paths from a given
    signaling point towards a specific destination.

- Message length (payload accepted from SS7 user parts)
  - 272 bytes for narrowband SS7, 4091 bytes for broadband SS7

4.2.3 SS7 User Part Requirements

   More detailed analysis of SS7 User Part Requirements can be found in
   [Lin].

   ISUP Message Delay - Protocol Timer Requirements

   - one example of ISUP timer requirements is the Continuity Test
     procedure, which requires that a tone generated at the sending
     end be returned from the receiving end within 2 seconds of
     sending an IAM indicating continuity test. This implies that
     one way signaling message transport, plus accompanying nodal
     functions need to be accomplished within 2 seconds.

   ISUP Message Delay - End-to-End Requirements

   - the requirement for end-to-end call setup delay in ISUP is that
     an end-to-end response message be received within 20-30 seconds
     of the sending of the IAM. Note: while this is the protocol
     guard timer value, users will generally expect faster response
     time.

   TCAP Requirements - Delay Requirements

   - TCAP does not itself define a set of delay requirements. Some
     work has been done [Lin2] to identify application-based delay
     requirements for TCAP applications.

4.2.4 ISDN Signaling Requirements

   Q.931 Message Delay

   - round-trip delay should not exceed 4 seconds. A Timer of this
     length is used for a number of procedures, esp. RELASE/RELEASE
     COMPLETE and CONNECT/CONNECT ACK where excessive delay may
     result in management action on the channel, or release of a
     call being set up. Note: while this value is indicated by
     protocol timer specifications, faster response time is normally
     expected by the user.

- 12 sec. timer (T309) is used to maintain an active call in
  case of loss of the data link, pending re-establishment. The
  related ETSI documents specify a maximum value of 4 seconds
  while ANSI specifications [T1.607] default to 90 seconds.

5. Management

   Operations, Administration & Management (OA&M) of IP networks or SCN
   networks is outside the scope of SIGTRAN. Examples of OA&M include
   legacy telephony management systems or IETF SNMP managers. OA&M
   implementors and users should be aware of the functional interactions
   of the SG, MGC and MG and the physical units they occupy.

6. Security Considerations

6.1 Security Requirements

   When SCN related signaling is transported over an IP network two
   possible network scenarios can be distinguished:

   - Signaling transported only within an Intranet;
     Security measures are applied at the discretion of the network
     owner.

   - Signaling transported, at least to some extent, in the public
     Internet;
     The public Internet should be regarded generally as an "insecure"
     network and usage of security measures is required.

   Generally security comprises several aspects

   - Authentication:
     It is required to ensure that the information is sent to/from a
     known and trusted partner.

   - Integrity:
     It is required to ensure that the information hasn't been modified
     while in transit.

   - Confidentiality:
     It might be sometimes required to ensure that the transported
     information is encrypted to avoid illegal use.

   - Availability:
     It is required that the communicating endpoints remain in service
     for authorized use even if under attack.

6.2 Security Mechanisms Currently Available in IP Networks

   Several security mechanisms are currently available for use in IP
   networks.

   - IPSEC ([RFC2401]):
      IPSEC provides security services at the IP layer that address the
      above mentioned requirements. It defines the two protocols AH and
      ESP respectively that essentially provide data integrity and data
      confidentiality services.

      The ESP mechanism can be used in two different modes:
      - Transport mode;
      - Tunnel mode.

   In Transport mode IPSEC protects the higher layer protocol data
   portion of an IP packet, while in Tunnel mode a complete IP packet is
   encapsulated in a secure IP tunnel.

   If the SIG embeds any IP addresses outside of the SA/DA in the IP
   header, passage through a NAT function will cause problems. The same
   is true for using IPsec in general, unless an IPsec ready RSIP
   function is used as described in RFC 2663 [NAT].

   The use of IPSEC does not hamper the use of TCP or UDP as the
   underlying basis of SIG. If automated distribution of keys is
   required the IKE protocol ([RFC2409]) can be applied.

   - SSL, TLS ([RFC2246]):
      SSL and TLS also provide appropriate security services but operate
      on top of TCP/IP only.

   It is not required to define new security mechanisms in SIG, as the
   use of currently available mechanisms is sufficient to provide the
   necessary security. It is recommended that IPSEC or some equivalent
   method be used, especially when transporting SCN signaling over
   public Internet.

7. Abbreviations

    CAS   Channel-Associated Signaling
    DSS1 Digital Subscriber Signaling
    INAP Intelligent Network Application Part
    ISEP IP Signaling End Point
    ISUP Signaling System 7 ISDN User Part
    MAP   Mobile Application Part
    MG   Media Gateway
    MGU   Media Gateway Unit
    MGC   Media Gateway Controller
    MGCU Media Gateway Controller Unit
    MTP   Signaling System 7 Message Transfer Part
    PLMN Public Land Mobile Network
    PSTN Public Switched Telephone Network
    S7AP SS7 Application Part
    S7UP SS7 User Part
    SCCP SS7 Signaling Connection Control Part
    SCN   Switched Circuit Network
    SEP   Signaling End Point
    SG   Signaling Gateway
    SIG   Signaling Transport protocol stack
    SS7   Signaling System No. 7
    TCAP Signaling System 7 Transaction Capabilities Part

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