              Digital Private Network Signaling System (DPNSS)/
                 Digital Access Signaling System 2 (DASS 2)
                       Extensions to the IUA Protocol

Status of This Memo

   This document specifies an Internet standards track protocol for the
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Abstract

   This document defines a mechanism for backhauling Digital Private
   Network Signaling System 1 (DPNSS 1) and Digital Access Signaling
   System 2 (DASS 2) messages over IP by extending the ISDN User
   Adaptation (IUA) Layer Protocol defined in RFC 3057. DPNSS 1,
   specified in ND1301:2001/03 (formerly BTNR 188), is used to
   interconnect Private Branch Exchanges (PBX) in a private network.
   DASS 2, specified in BTNR 190, is used to connect PBXs to the PSTN.
   This document aims to become an Appendix to IUA and to be the base
   for a DPNSS 1/DASS 2 User Adaptation (DUA) implementation.

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1. Introduction

   This document describes a method of implementing Digital Private
   Network Signaling System 1 (DPNSS 1) [2] (henceforth referred to as
   just DPNSS) and Digital Access Signaling System 2 (DASS 2)[3]
   backhaul messaging over IP using a modified version of the ISDN User
   Adaptation Protocol (IUAP) [1]. The DPNSS/DASS 2 User Adaptation
   (DUA) builds on top of IUA by defining the necessary extensions to
   IUA for a DPNSS/DASS2 implementation.

1.1. Scope

   There is a need for Switched Circuit Network (SCN) signaling protocol
   delivery from a DPNSS Signaling Gateway (SG) to a Media Gateway
   Controller (MGC). The delivery mechanism should support the
   following protocols:

      - DPNSS (Digital Private Network Signaling System) [2]
      - DASS 2 (Digital Access Signaling System Number 2) [3]

Unless specifically mentioned, the details in this document are applicable to both DPNSS and DASS 2.

1.2. Terminology

Data channel (D-channel) - A 64 kbit/s time slot that functions as a common signaling channel on a 2048 kbits/s interface or a 1544 kbits/s interface that is provisioned to carry DPNSS signaling.

DPNSS channel - Time slots 1 to 15 and 17 to 31 on a 2048 kbits/s interface or Time slots 1 to 23 on a 1544 kbits/s interface are termed as DPNSS channels. These are the traffic channels that carry voice or data traffic.

   - DPNSS supports 60 Channels (30 Real and 30 Virtual)
   - DASS2 supports 30 Channels (All Real)

Data Link Connection(DLC) - A DLC is the level 2 process that controls the transfer of level 3 messages on behalf of one DPNSS channel. A DLC uniquely identifies one DPNSS channel.

   - DPNSS supports 60 DLCs (30 Real and 30 Virtual)
   - DASSII supports 30 DLCs (All Real)

DPNSS Link - A logical collection of the D-channel and the associated DPNSS channels in a 2048 kbits/s interface or a 1544 kbits/s interface is called a "DPNSS Link".

Real channel - A signalling channel with an associated traffic channel (TS).

Virtual channel - A signalling channel with no associated traffic channel.

NT1 - The DPNSS minimum retransmission period.

NT2 - The DPNSS minimum post retransmission acknowledgement delay.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [5].

1.3. DPNSS Overview

DPNSS is an industry standard interface (ref. ND1301:2001/03) [2],
which is defined between a PBX and an Access Network (AN). DPNSS
extends facilities that are normally only available between
extensions on a single PBX to all extensions on PBXs that are
connected in a private network. DPNSS was originally derived from
BT's Digital Access Signaling System I (DASS I), and was enhanced
where necessary to meet the private network requirements. Some of
these enhancements were incorporated in DASS 2 [3]. DPNSS uses a
2048 kbits/s or 1544 kbits/s Digital Transmission System Interface,
as shown in Figure 1 below.

```
         ----------                ----------         o--o
        |          | 2048 kbits/s |          |------- /\
        |          |--------------|          |        --
        |   PBX    | 1544 kbits/s |    AN    |
        |          |--------------|          |        o--o
        |          |              |          |------- /\
         ----------                ----------         --
```

                          Figure 1

Channel 16 is on a 2048 kbits/s (E1) interface and channel 24 is on a
1544 kbits/s (T1) interface and is reserved for data communication
between LE and AN. The channels reserved for data are called "Data
Channels" or "D-Channels."

The D-Channels are the physical media used to exchange data between
the DPNSS protocol peer entities. A logical collection of the
D-channel and the associated DPNSS channels is called a "DPNSS Link".

1.4. Proposed DPNSS Backhaul Architecture
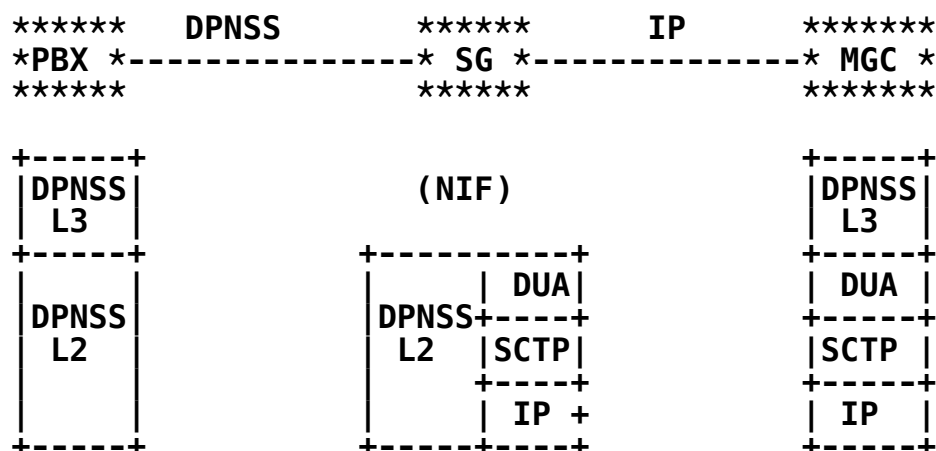
```
         ******    DPNSS         ******     IP      *******
         *PBX *---------------* SG *--------------* MGC *
         ******                ******             *******

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

            NIF  - Nodal Interworking function
            SCTP - Stream Control Transmission Protocol
            DUA  - DPNSS User Adaptation Layer Protocol
```

2. Changes from IUA

This section outlines the differences between DUA and IUA.

2.1. New Message Class for DUA

The DPNSS/DASS2 Layer 2 to Layer 3 primitives [2] [3] need to be
identifiable from IUA boundary primitive transport messages and the
boundary primitive transport messages of other IUA extensions (i.e.,
V5 or GR-303). Therefore, it is necessary to use a different message
class parameter for DUA messages.

For all DPNSS/DASS2 interface boundary primitives, a new Message
Class is introduced:

        13   DPNSS/DASS2 Boundary Primitives Transport Messages
                (DPTM)

Similar to IUA, other valid message classes for DUA are:

        0   Management (MGMT) Message
        3   ASP State Maintenance (ASPSM) Messages
        4   ASP Traffic Maintenance (ASPTM) Messages

2.2. Message Header

   The IUA Message Header [1] MUST be used with the DPTM messages, but
   the DLCI field in the DLCI parameter is formatted differently.
   Figure 2 below shows the IUA Message Header with integer-based
   Interface Identifier.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            Tag (0x1)          |              Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Interface Identifier (integer)               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            Tag (0x5)          |              Length=8          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             DLCI             |              Spare              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
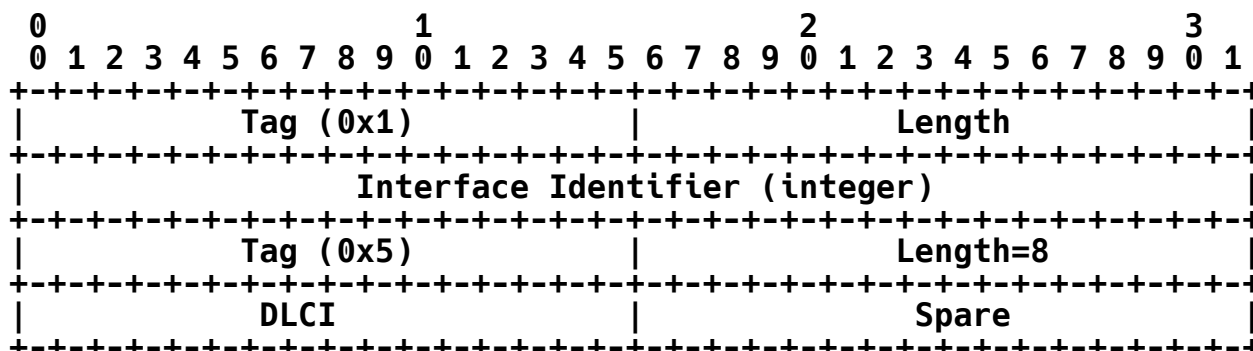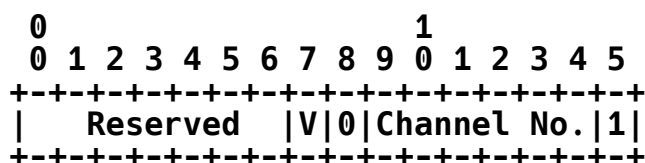
   Figure 2 IUA Message Header (integer-based Interface Identifier)

   In DUA, the DLCI field has a different format, in accordance with the
   ND1301:2001/03 (formerly BTNR 188) [2].

```
     0                   1
     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |    Reserved   |V|0|Channel No.|1|
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Reserved: 7 bits

   Should be set to all '0's and ignored by the receiver.

   V-bit: 1 bit

      The V-bit is used to determine if the message is for a particular
      DLC or if it is applicable for all the DLCs in the carrier. The
      possible values of the V-bit are listed below:

```
            Value          Description
            0              Action is to be performed on all DLCs;
                           Channel number parameter is ignored.
            1              Action is to be performed on a single
                           DLC specified by channel number.
```

This V-bit value is used only by the Establish and Release
messages. Data messages should ignore this value. This indicator
is provided so that a single command can be issued to establish or
release all the DLCs in one DPNSS Link.

For Channel Number (Channel No.), the valid values are 0 to 63 for
DPNSS and 0 to 31 for DASS 2. This is because DASS 2 does not
support virtual DLCs and, hence, has only 32 DLCs.

2.3. Unit Data Message

DPNSS layer 2 does not have a unit data primitive and, hence, the
Unit Data Messages (Request, Indication) are invalid for a DUA
application. The Data Request and Indication messages (message types
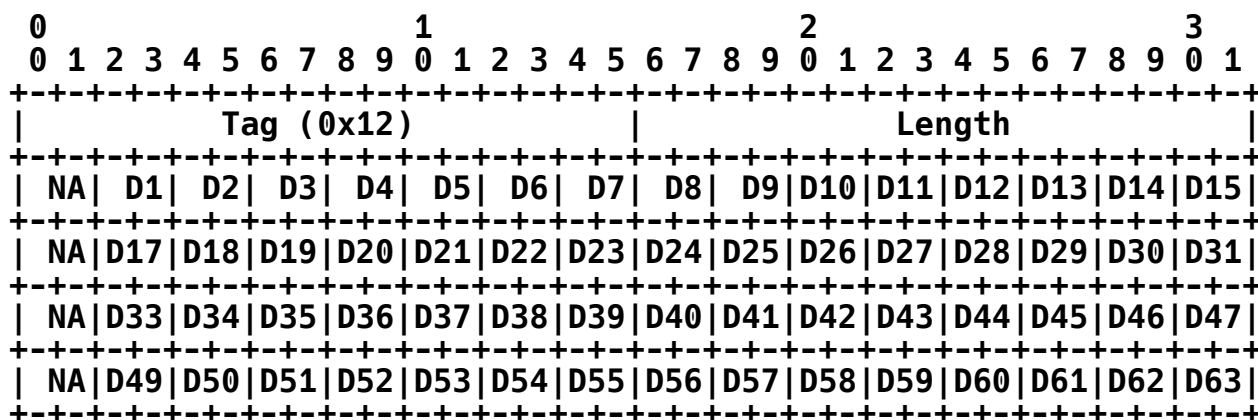1 and 2, respectively) will be used with DUA.

2.4. DLC Status Message

For DUA, a new message is necessary to carry the status of the DLCs.
This message will be a Management message (i.e., its message class
will be a value of 0 for Management). The following message types
will be used for these messages:

    5   DLC Status Request
    6   DLC Status Confirm
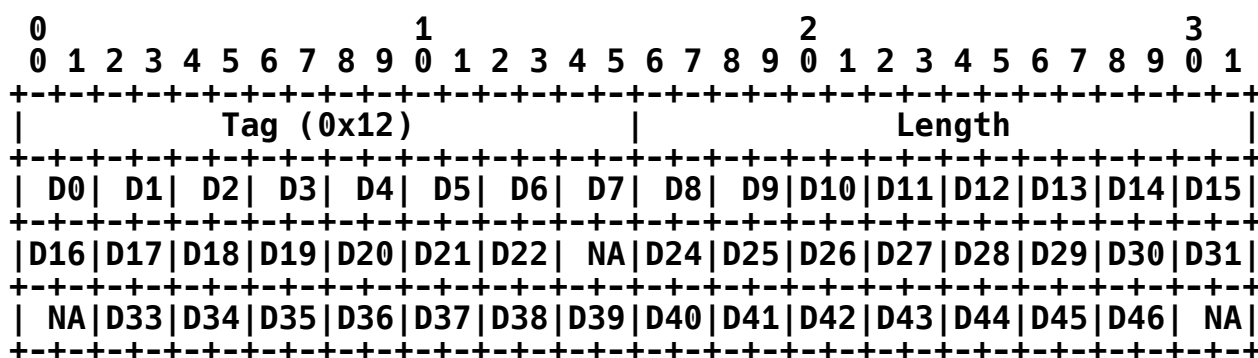   7   DLC Status Indication

The DLC Status messages are exchanged between DUA layer peers to
request, confirm, and indicate the status of the DLCs. The DLC
Status messages contain the common message header, followed by IUA
message header, as described in section 2.2.

   In addition, the DLC Status Confirm and Indication messages will
   contain the new parameter, called the DLC Status parameter. This
   parameter will have the following format for an E1 interface:

```
0                   1                   2                   3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           Tag (0x12)          |            Length             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| NA| D1| D2| D3| D4| D5| D6| D7| D8| D9|D10|D11|D12|D13|D14|D15|
| NA|D17|D18|D19|D20|D21|D22|D23|D24|D25|D26|D27|D28|D29|D30|D31|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| NA|D33|D34|D35|D36|D37|D38|D39|D40|D41|D42|D43|D44|D45|D46|D47|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| NA|D49|D50|D51|D52|D53|D54|D55|D56|D57|D58|D59|D60|D61|D62|D63|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   NA stands for Not Applicable. D0 and D16 are not applicable for an
   E1 interface because timeslot 0 is used for E1 framing and
   synchronization bits and timeslot 16 is used for signaling. For
   DPNSS, there would be a total of max 60 DLCs (30 real + 30 virtual)
   and in case of DASS2 there would be a total of 30 DLCs (no virtuals).

   This parameter will have the following format for a T1 interface:

```
0                   1                   2                   3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           Tag (0x12)          |            Length             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| D0| D1| D2| D3| D4| D5| D6| D7| D8| D9|D10|D11|D12|D13|D14|D15|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|D16|D17|D18|D19|D20|D21|D22| NA|D24|D25|D26|D27|D28|D29|D30|D31|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| NA|D33|D34|D35|D36|D37|D38|D39|D40|D41|D42|D43|D44|D45|D46| NA|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   D23 is not applicable for a T1 interface because timeslot 23 is used
   for signaling. For DPNSS, there would be a total of max 46 DLCs (23
   real + 23 virtual) and in case of DASS2 there would be a total of 23
   DLCs (no virtuals).

The parameter carries the status of DLCs using two bits for each DLC.
The possible values for the two bits are shown below:

```
        Value            Description
         00          Out Of Service
         01          Reset Attempted
         10          Reset Completed
         11          Information Transfer
```

For DASS 2, the value 00 (Out Of Service) is invalid because the DASS
2 DLC does not have this state. In addition, the Idle state is a
transient state local to the DLC, therefore, a value is not allocated
for it.

For DASS 2, there are no virtual DLCs and, hence, information about
only 32 DLCs need to be carried. Therefore, the status message will
have a length of 12 for a DASS 2 DLC Status message.

2.5. Management (MGMT) Messages

Only the Notify and Error messages are valid for DUA. The TEI Status
messages are not used.

2.5.1. Error Message

The ERR message is sent when an invalid value or unrecognized message
is found in an incoming message.

The Error Code parameter indicates the reason for the Error Message.
These are the supported values in IUA.

```
   Invalid Version                            0x01
   Invalid Interface Identifier               0x02
   Unsupported Message Class                  0x03
   Unsupported Message Type                   0x04
   Unsupported Traffic Handling Mode          0x05
   Unexpected Message                         0x06
   Protocol Error                             0x07
   Unsupported Interface Identifier Type      0x08
   Invalid Stream Identifier                  0x09
   Unassigned TEI                             0x0a
   Unrecognized SAPI                          0x0b
   Invalid TEI, SAPI combination              0x0c
   Refused - Management Blocking              0x0d
   ASP Identifier Required                    0x0e
   Invalid ASP Identifier                     0x0f
```

In DUA, the error codes 0x0a, 0x0b, and 0x0c are invalid, as they are
specific to ISDN.

The following additional error codes are supported in DUA:

        Channel Number out of range   0x1c
        Channel Number not configured   0x1d

The "Channel Number out of range" error is sent if a message is
received with a channel number greater than 63 for DPNSS or 31 for
DASS 2.

The "Channel Number not configured" error is sent if a message is
received with a channel number that is not configured.

3. IANA Considerations

    IANA has assigned a DUA value for the SCTP Payload Protocol
    Identifier field that is used in SCTP Payload Data chunks. The
    following value for the SCTP Payload Protocol Identifier field SHOULD
    be used for DUA:

        SCTP Payload Protocol ID = "10"

4. Use of SCTP Payload Protocol ID

    As an option, the IUA value for SCTP Payload Protocol ID MAY also be
    used for DUA, for instance, if one wanted to backhaul ISDN and DPNSS
    over the same SCTP association. However, use of separate SCTP
    Payload Protocol IDs (10 for DUA and 1 for IUA) is recommended as the
    primary option, even in scenarios where ISDN and DPNSS are backhauled
    over the same SCTP association.

    SCTP Payload Protocol ID of "10" SHOULD be used for DUA if only DPNSS
    is backhauled over an SCTP association (i.e., in scenarios where
    simultaneous backhauling of ISDN and DPNSS over the same association
    is NOT required).

    The SCTP Payload Protocol Identifier is included in each SCTP Data
    chunk, to indicate which protocol the SCTP is carrying. This Payload
    Protocol Identifier is not directly used by SCTP but MAY be used by
    certain network entities to identify the type of information being
    carried in a Data chunk.

5. Message Sequence in DUA

    An example of the message flows for establishing a data link on a
    signaling channel, passing PDUs and releasing a data link on a DPNSS
    channel is shown below. An active association between MGC and SG is
    established prior to the following message flows.

5.1. Resetting of single DLC

        i) Successful

     PBX   SG   MGC
         <----------- SABMR   <----------- Est Req(Ind=1)
      UA   ----------->   Est Cfm -----------> (DLC in RC State)
                                   Ind=1)

        ii) Unsuccessful(Link Failure)

       PBX   SG   MGC
          <----------- SABMR   <----------- Est Req(Ind=1)
            Retransmissions over
            NT1 and NT2 expired

                                Rel Ind -----------> (DLC in RA state)
                              (RELEASE_OTHER,Ind=1)

5.2. Resetting all DLCs in a Link

       PBX   SG   MGC
          <----------- SABMR(1)   <----------- Est Req(Ind=0)
          <----------- SABMR(2)
          <----------- SABMR(3)
          ....
          <----------- SABMR(N)
            In each DLC either
            UA is received or
            NT1/NT2 is expired

                               Est Cfm -----------> (Status of DLCs
                               (Ind=0)   are not updated)
                                      <----------- Status Req
                           Status cfm ----------> (Mark DLC status
                                                    based on
                                                    status bits)

    If one of more DLCs remains out-of-service after this procedure
    (e.g., due to layer 2 management), the MGC can either retry this DLC
    with an Est Req(Ind=1) indicating the specific DLC or with an

Est Req(Ind=0) and the SG will retry the appropriate DLC that is
out-of-service.

5.3. Information Transfer on a DLC

```
        PBX                         SG                          MGC
          <----------- UI(C)                  <----------- Data Req
        UI(R)----------->           Data Ind ----------->
```

5.4. Link Takedown (Single DLC)

```
        PBX                         SG                          MGC
          (For DPNSS, mark DLC as OOS)    <----------- Rel Req
          (For DASSII, mark DLC as RA)              (RELEASE_MGMT,
                                                       Ind=1)
                                  Rel Cfm  ---------->
                                  (Ind=1)
```

5.5. Link Takedown (All DLCs)

```
        PBX                         SG                          MGC
          (For DPNSS, mark all DLCs as OOS) <-------- Rel Req
          (For DASSII, mark DLC as RA)              (RELEASE_MGMT,
                                                       Ind=0)
                                  Rel Cfm  ---------->
                                  (Ind=0)
```

5.6. Getting Link Status

```
        PBX                         SG                          MGC
                                          <----------- Stat Req
                                  Stat Cfm -----------> (Mark DLC status
                                                        based on
                                                        status bits)
```

5.7. Error Conditions

```
        PBX                         SG                          MGC
                          Invalid Message <-----------Est/Rel/Data/-
                                                       Stat Req
                                  Error Ind    ----------->
                                  (Error Code)
```

6. Security Considerations

The security considerations for the ISDN User Adaptation Protocol (IUAP) [1] (Section 6) and the security considerations for SIGTRAN Protocols document [4] apply to this document as well.

7. References

7.1. Normative References

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

[2] Ofcom/NICC ND1301:2001/03, DPNSS [188], Digital Private Signalling System No 1 (DPNSS 1) (Formerly BTNR 188).

[3] BTNR (British Telecom Network Requirements) 190 Issue 2 Digital Access Signaling System No 2.

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

[5] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

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