DPNSS/DASS 2 extensions to the IUA protocol
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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
   and 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.

Table of Contents

1.0 Introduction

   This document describes a method of implementing Digital Private
   Network Signaling System 1 (DPNSS 1) [2] - henceforth just 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 which functions
   as a common signaling channel on a 2048 kbits/s interface or a
   1544 kbits/s interface which 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 which 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 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.

1.3 DPNSS Overview

   DPNSS is an industry standard interface (ref. ND1301:2001/03) [2]
   defined between a PBX and an Access Network (AN). DPNSS extends
   facilities normally only available between extensions on a single
   PBX to all extensions on PBXs that are connected together in a
   private network. DPNSS was originally derived from BT's Digital
   Access Signaling System I (DASS I) 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
     |        |              |        |-------  /\
     ----------            ----------           --
```
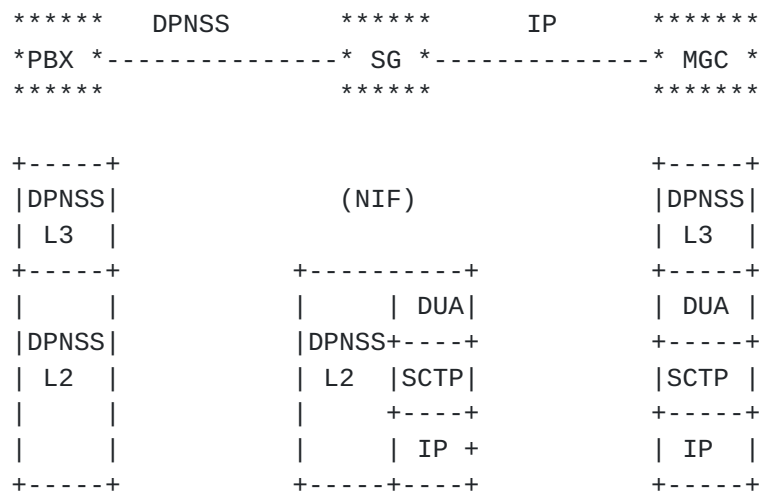
                    Figure 1

   Channel 16 on a 2048 kbits/s (E1) interface and channel 24 on a
   1544 kbits/s (T1) interface 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 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

2.0 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 neccessary 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             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
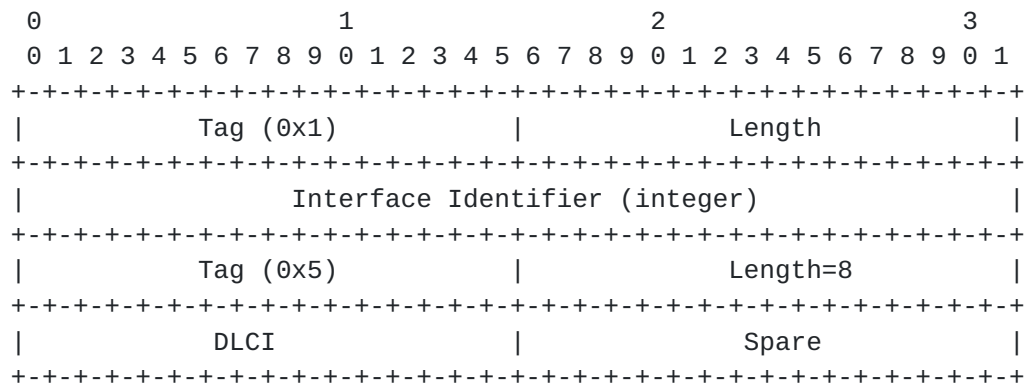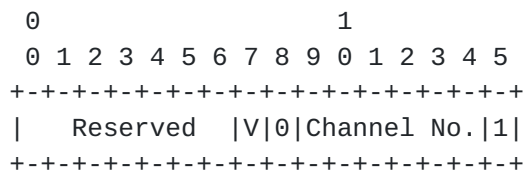
 Figure 2 IUA Message Header (integer-based Interface Identifier)

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 whether the message is for
a particular DLC or 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 IUA 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 2.1.

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 since the DASS 2

DLC does not have this state. In addition, the Idle state is a
transient state local to the DLC so 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.

3.0 IANA Considerations

IANA has assigned a DUA value for the SCTP Payload Protocol
        Identifier field 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"

4.0 Use of SCTP Payload Protocol ID

As an option, 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 a 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.

The User Adaptation peer MAY use the Payload Protocol Identifier as
a way of determining whether the message is for IUA or DUA.

5.0 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
   a 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)
```

6.0 Security Considerations

   The security considerations discussed for the ISDN User Adaptation
   Protocol (IUAP) [1] Section 6.0 and the Security Considerations
   for SIGTRAN Protocols document [4] apply to this document as well.

7.0 References

7.1 Normative References

   [1] Morneault, et al., ISDN Q.921-User Adaptation Layer RFC3057)
   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, et al., Security Considerations for Signaling
   Transport (SIGTRAN) Protocols, RFC 3788, June 2004

7.2 Informative References

   [5] ETS 300 167 (08/1993) : Transmission and Multiplexing;
   Functional characteristic of 2048 kbits/s interfaces
   (Standard is based on G.704, G.706).

8.0 Acknowledgments

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