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        Layer 2 Tunneling Protocol (L2TP) Access Line Information
                  Attribute Value Pair (AVP) Extensions
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Abstract

   This document describes a set of Layer 2 Tunneling Protocol (L2TP)
   Attribute Value Pair (AVP) extensions designed to carry the
   subscriber Access Line identification and characterization
   information that arrives at the Broadband Remote Access Server (BRAS)
   with L2TP Access Concentrator (LAC) functionality. It also describes
   a mechanism to report connection speed changes, after the initial
   connection speeds are sent during session establishment. The primary
   purpose of this document is to provide a reference for DSL equipment
   vendors wishing to interoperate with other vendors' products. The
   L2TP AVPs defined in this document are applicable to both L2TPv2 and
   L2TPv3.

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1. Introduction

   Access Nodes/Digital Subscriber Line Access Multiplexers (DSLAM) are
   adding enhancement features to forward, via in-band signaling,
   subscribers Access Line identification and characterization
   information to their connected upstream Broadband Remote Access
   Server (BRAS) with L2TP Access Concentrator (LAC) functionality.

   The Access Node/DSLAM may forward the information via one or more of
   the following methods:

   o Vendor-Specific PPPoE Tags [RFC2516].

   o DHCP Relay Options [RFC3046] and Vendor-Specific Information
      Suboptions [RFC4243].

   o ANCP [I-D.ietf-ancp-protocol].

   Currently this information is been collected on the BRAS and
   forwarded to a radius server via [RFC4679].

   This document describes the new additional L2TP AVPs that were
   created to forward the subscriber line identification and
   characterization information received at the BRAS/LAC to the
   terminating L2TP Network Server (LNS). It also describes a mechanism
   by which the LAC may report connection speed changes to the LNS,
   after the initial connection speeds are sent by the LAC during
   session establishment.

   The L2TP AVPs defined in this document MAY be used with either an
   L2TPv2 [RFC2661] or L2TPv3 [RFC3931] implementation.

   The information acquired may be used to provide authentication,
   policy and accounting functionality. It may also be collected and
   used for management and troubleshooting purposes.

2. Terminology

   The following sections define the usage and meaning of certain
   specialized terms in the context of this document.

2.1. Requirements Language

   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 [RFC2119].

2.2. Technical Terms and Acronyms

   Access Node/DSLAM

      The Access Node/DSLAM is a DSL signal terminator that contains a
      minimum of one Ethernet or ATM interface that serves as its
      upstream interface into which it aggregates traffic from several
      ATM-based (subscriber ports) or Ethernet-based downstream
      interfaces.

   BNG

      Broadband Network Gateway. A BNG is an IP edge router where
      bandwidth and QoS policies are applied; the functions performed by
      a BRAS are a superset of those performed by a BNG.

   BRAS

      Broadband Remote Access Server. A BRAS is a BNG and is the
      aggregation point for the subscriber traffic. It provides
      aggregation capabilities (e.g., IP, PPP, Ethernet) between the
      access network and the core network. Beyond its aggregation
      function, the BRAS is also an injection point for policy
      management and IP QoS in the access network.

   DSL

      Digital Subscriber Line. DSL is a technology that allows digital
      data transmission over wires in the local telephone network.

   DSLAM

      Digital Subscriber Line Access Multiplexer. DSLAM is a device
      that terminates DSL subscriber lines. The data is aggregated and
      forwarded to ATM- or Ethernet-based aggregation networks.

   IWF

      Interworking Function. The set of functions required for
      interconnecting two networks of different technologies (e.g., ATM
      and Ethernet). IWF is utilized to enable the carriage of PPPoA
      traffic over PPPoE.

   LAC

      L2TP Access Concentrator. If an L2TP Control Connection Endpoint
      (LCCE) is being used to cross-connect an L2TP session directly to
      a data link, we refer to it as an L2TP Access Concentrator (LAC).

(See [RFC2661] and [RFC3931].)

LCCE

   L2TP Control Connection Endpoint. An L2TP node that exists at
   either end of an L2TP control connection. May also be referred to
   as an LAC or LNS, depending on whether tunneled frames are
   processed at the data link (LAC) or network layer (LNS). (See
   [RFC3931].)

LNS

   L2TP Network Server. If a given L2TP session is terminated at the
   L2TP node and the encapsulated network layer (L3) packet processed
   on a virtual interface, we refer to this L2TP node as an L2TP
   Network Server (LNS). (See [RFC2661] and [RFC3931].)

3. Access Line Information L2TP AVP Operation

   When the BRAS with LAC functionality receives the Access Line
   information from the Access Node and has determined that the session
   will be established with an LNS, the LAC will forward the information
   that it has collected in the newly defined L2TP AVPs. The LAC will
   only forward the Access Line information AVPs that have populated
   values.

   Access Line information from any of the above methods must be
   available at the BRAS prior to the start of session negotiation by
   the LAC. This ensures Access Line parameters are reliably provided
   to the LNS and avoids additional call set-up delays. Under the
   condition that the LAC has not received any Access Line information
   from any of the methods, as default behavior the LAC SHOULD establish
   the L2TP session without waiting for the Access Line Information. In
   this case, the LAC MUST NOT send any of the Access Line AVPs to the
   LNS. The LAC MAY, as local policy, wait for the Access Line
   information from one or more of the methods before forwarding the
   information in the Access Line L2TP AVPs to the LNS.

   It is possible that the Access Node will only send a subset of the
   currently available line information defined. The LAC MUST be able
   to limit and/or filter which AVPs, if any, are sent to the LNS.

   It is also possible that the LAC may receive Access Line information
   from multiple sources and at different time intervals. Local policy
   SHOULD determine which source(s) the LAC will accept. The LAC SHOULD
   default to accepting ANCP sourced parameters.

The Access Line AVPs are sent as part of the L2TP Incoming-Call-Request (ICRQ) control message. Connect Speed Update AVPs are sent as part of the Connect-Speed-Update-Notification (CSUN) or Connect-Speed-Update-Request (CSURQ) L2TP messages (see Sections 4, 4.1, and 4.2).

It is possible for the LAC to send updated Connect Speed characteristics to the LNS via the Connect Speed Update AVP in an L2TP Connect-Speed-Update-Notification (CSUN) control message (see Section 4.1). To avoid unnecessary L2TP Connect-Speed-Update-Request and Connect-Speed-Update-Notification message exchanges between the LAC and LNS (e.g., during failover protocol recovery and resynchronization), the LAC signals in the session establishment exchange its ability and desire to provide speed updates during the life of the session. This is achieved using a new AVP, Connect Speed Update Enable (see Section 6.2), sent in the L2TP Incoming-Call-Request (ICRQ) control message. The absence of this AVP in the ICRQ message implies that the LAC will not be sending any speed updates during the life of the session. If the LAC is configured to accept ANCP-sourced parameters, and supports providing speed updates during the life of a session, it MUST send the Connect Speed Update Enable AVP in the ICRQ, since this implies that speed updates may occur over the life of the connection. If the LAC is configured to only accept PPPoE vendor-specific tags, it MUST NOT send the Connect Speed Update Enable AVP in the ICRQ, since the connection speed is only sent during PPPoE discovery and no further updates will occur during the life of the connection.

4. Additional L2TP Messages

If the Access Line information changes while the session is still maintained, connection speed updates MAY be sent from the LAC to the LNS via an L2TP Connect-Speed-Update-Notification (CSUN) Message (see Section 4.1). A new AVP, Connect Speed Update AVP (see Section 6.1), is included in the CSUN message to report connect speed updates for a specific session after the initial connection speeds are established (i.e., at session establishment via the Tx Connect Speed and Rx Connect Speed AVPs, Attribute Types 24 and 38 respectively for L2TPv2 and 74 and 75 respectively for L2TPv3). The values established in the Connect Speed Update AVP (as well as the values for the initial Tx/Rx Connect Speeds AVPs) are based on LAC local policy. For example, the LAC's local policy may use the Actual-Data-Rate-Upstream and Actual-Data-Rate-Downstream as its policy to report connection speed updates. For consistency, the same local policy SHOULD equally apply both to the initial connect speeds (conveyed during session establishment) and to the (optional) connect speed updates (sent after the establishment of the session). The CSUN message MAY be

sent periodically to the LNS based on local policy and may include
more than one Connect Speed Update AVP. The bulking of more than one
Connect Speed Update AVP into the CSUN message serves the following
purposes:

o Dampen the rate of changes sent to the LNS when Access Line
   parameter updates are received at a high rate for a given line.

o Efficiently forward speed updates when Access Line parameter
   updates are received for many lines at the same time.

o Address failover [RFC4951] protocol recovery and
   resynchronization.

During failover recovery and resynchronization, to ensure the correct
speeds have been applied to outstanding sessions on each tunnel, the
LNS MAY issue a Connect-Speed-Update-Request (CSURQ) message (see
Section 4.2) to the LAC containing one or more Session IDs. In
response to the CSURQ message, the LAC MUST issue a Connect-Speed-
Update-Notification (CSUN) message (see Section 4.1) containing a
Connect Speed Update AVP for each of the Session IDs requested in the
CSURQ. Note: In the CSUN response to the CSURQ, the LAC MUST NOT
respond to unknown sessions, or to known sessions for which it did
not issue a Connect Speed Update Enable AVP in the prior Incoming-
Call-Request (ICRQ) control message for the session (see Sections 3
and 6.2).

This section defines two new Messages that are used with the IETF
Vendor ID of 0 in the Message Type AVP.

   The following message types will be assigned to these new messages
   (see Section 8.1):

   MSG-TBD1: (CSUN) Connect-Speed-Update-Notification

   MSG-TBD2: (CSURQ) Connect-Speed-Update-Request

The Mandatory (M) bit within the Message Type AVP SHOULD be clear
(i.e., not set) for the CSUN and CSURQ control messages, to allow for
an L2TP Control Connection Endpoint (LCCE) to maintain the control
connection if the message type is unknown.

4.1. Connect-Speed-Update-Notification (CSUN)

The Connect-Speed-Update-Notification (CSUN) is an L2TP control
message sent by the LAC to the LNS to provide transmit and receive
connection speed update for one or more sessions. The connection
speed may change at any time during the life of the call, thus the

   LNS SHOULD be able to update its connection speed on an active
   session.

   The following AVPs MUST be present in the CSUN:

      Message Type

      Connect Speed Update (more than one may be present in the CSUN)

   Note that the LAC MUST NOT include a Connect Speed Update AVP for
   which it did not send a Connect Speed Update Enable AVP in the prior
   Incoming-Call-Request (ICRQ) control message for the session.

4.2. Connect-Speed-Update-Request (CSURQ)

   The Connect-Speed-Update-Request (CSURQ) is an L2TP control message
   sent by the LNS to the LAC to request the current transmit and
   receive connection speed for one or more sessions. It MAY be issued
   at any time during the life of the tunnel and MUST only be issued for
   each outstanding session on each tunnel on which the LNS has already
   received a Connect Speed Update Enable AVP in the prior Incoming-
   Call-Request (ICRQ) control message for the session. It is typically
   used as part of failover recovery and re-synchronization to allow the
   LNS to verify it has the correct speeds for each outstanding session
   on each tunnel.

   The following AVPs MUST be present in the CSURQ:

      Message Type

      Connect Speed Update (more than one may be present in the CSURQ)

   The Current Tx Connect Speed and Current Rx Connect Speed fields in
   the Connect Speed Update AVP MUST be set to 0 when this AVP is used
   in the CSURQ message.

   In the CSUN response to the CSURQ, the LAC MUST NOT respond to
   unknown sessions, or to known sessions for which it did not issue a
   Connect Speed Update Enable AVP in the prior Incoming-Call-Request
   (ICRQ) control message for the session.

5. Access Line Information L2TP Attribute Value Pair Extensions

   The Access Line Information was initially defined in the DSL Forum
   Technical Report TR-101 [TR-101]. TR-101 defines the line
   characteristic that are sent from an Access Node.

The following sections contain a list of the Access Line Information
L2TP AVPs. Included with each of the listed AVPs is a short
description of the purpose of the AVPs.

The AVPs follow the standard method of encoding AVPs as follows:

```
  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
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |M|H| rsvd  |      Length       |          Vendor ID          |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |         Attribute Type        |Attribute Value, if Required ...
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                   ... (Until Length is reached)                |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The M bit for all the AVPs defined in this document SHOULD be set to
0, to allow for backwards compatibility with LNS that do not support
the Access Line Information AVP extensions hereby defined. However,
if it is desired to prevent the establishment of the L2TP session if
the peer LNS does not support the Access Line Information AVP
extensions, the M bit MAY be set to 1. See Section 4.2 of [RFC2661]
and Section 5.2 of [RFC3931].

All the AVPs defined in this document MAY be hidden (the H bit MAY be
0 or 1).

The Length (before hiding) of all the listed AVPs is 6 plus the
length of the Attribute Value, if one is required, in octets.

The Vendor ID for all the listed AVP (Section 5.1 through
Section 5.19) is that of the IANA assigned ADSL Forum Vendor ID,
decimal 3561 [IANA.enterprise-numbers].

All the listed AVPs (Section 5.1 through Section 5.19) MAY be present
in the following messages unless otherwise stipulated:

    Incoming-Call-Request (ICRQ)

The Value of the AVP contains information about the Access line to
which the subscriber is attached.

With exception of the Connect Speed Update AVP (see Section 6.1), all
new AVPs specifying a data rate or speed expressed in bits per second
(bps) will be sent as 64-bits to provide extensibility to support
future increases in subscriber connection speeds. These new AVPs
that specify a 64-bit "Data-Rate" are defined from Section 5.3 to
Section 5.12, both inclusive. Whenever a speed value sent in an AVP

fits within 32 bits, the upper 32 bits MUST be transmitted as 0s.

The various Data-Rates and Interleaving-Delays used in the subsequent
Sections 5.3 through 5.16 are defined in Section 3.9.4 of [TR-101].
The qualifiers used with these Data-Rates and Interleaving-Delays
have the following meanings:

o Actual   Actual rate or delay of an access loop

o Attainable Maximum value that can be achieved by the equipment

o Minimum   Minimum value configured by the operator

o Maximum   Maximum value configured by the operator

5.1. Access Line Agent-Circuit-Id AVP

The Access Line Agent-Circuit-Id AVP, Attribute Type 1, contains
information describing the subscriber agent circuit ID corresponding
to the logical access loop port of the Access Node/DSLAM from which a
subscriber's requests are initiated.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Agent-Circuit-ID ... (two to sixty three octets)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Agent-Circuit-Id is of arbitrary length, but MUST be greater than
1 octet and not greater than 63 octets.

The Length (before hiding) of this AVP is 6 plus the length of the
Agent-Circuit-ID.

The Agent-Circuit-ID contains information about the Access-Node/DSLAM
to which the subscriber is attached, along with a unique identifier
for the subscriber's DSL port on that Access-Node/DSLAM. The Agent-
Circuit-ID contains a locally administered string representing the
access loop logical port, and its syntax is defined in Section 3.9.3
of [TR-101]. The text string is encoded in the UTF-8 charset
[RFC3629].

An exemplary description of the Agent-Circuit-Id string format
follows for background purposes. The LAC MUST treat the string as an
opaque value and MUST NOT manipulate or enforce the format of the
string based on the description here or in TR-101 [TR-101].

Default syntax for the string is defined in [TR-101]. The examples
in this section are included only for illustrative purposes. The
exact syntax of the string is implementation dependant; however, a
typical practice is to subdivide it into two or more space-separated
components, one to identify the Access-Node and another the
subscriber line on that node, with perhaps an indication of whether
that line is Ethernet or ATM. Example formats for this string are
shown below.

    "Access-Node-Identifier atm slot/port:vpi.vci"
    (when ATM/DSL is used)

    "Access-Node-Identifier eth slot/port[:vlan-id]"
    (when Ethernet/DSL is used)

The syntax for the string is defined in [TR-101]. An example showing
the slot and port field encoding is given below:

    "Relay-identifier atm 3/0:100.33"
    (slot = 3, port = 0, vpi = 100, vci = 33)

The Access-Node-Identifier is a unique ASCII string which does not
include 'space' characters. The syntax of the slot and port fields
reflects typical practices currently in place. The slot identifier
does not exceed 6 characters in length and the port identifier does
not exceed 3 characters in length using a '/' as a delimiter.

The exact manner in which slots are identified is Access Node/DSLAM
implementation dependent. The vpi, vci and vlan-id fields (when
applicable) are related to a given access loop (U-interface).

5.2. Access Line Agent-Remote-Id AVP

The Access Line Agent-Remote-Id AVP, Attribute Type 2, contains an
operator-specific, statically configured string which uniquely
identifies the subscriber on the associated access loop of the Access
Node/DSLAM.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Agent-Remote-Id ... (two to sixty three octets)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Agent-Remote-Id is of arbitrary length, but MUST be greater than
1 octet and not greater than 63 octets.

The Length (before hiding) of this AVP is 6 plus the length of the
Agent-Remote-ID.

The Agent-Remote-ID contains information sent from the Access-Node/
DSLAM from which the subscriber is attached, to further refine the
access loop logical port identification with a user. The content of
this message is entirely open to the service provider's discretion.
For example, it MAY contain a subscriber billing ID or telephone
number. The LAC MUST treat the string as an opaque value and MUST
NOT manipulate or enforce its format. The text string is defined in
[TR-101], and is encoded in the UTF-8 charset [RFC3629].

5.3. Access Line Actual-Data-Rate-Upstream AVP

The Access Line Actual-Data-Rate-Upstream AVP, Attribute Type 129,
contains the actual upstream train rate of a subscriber's
synchronized Access link.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Actual-Data-Rate-Upstream
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                  ... in bps (64 bits)                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Actual-Data-Rate-Upstream is an 8-octet value.

The Actual-Data-Rate-Upstream AVP contains an 8-octet unsigned
integer, indicating the subscriber's actual data rate upstream of a
synchronized Access link. The rate is coded in bits per second.

The Length (before hiding) of this AVP is 14.

5.4. Access Line Actual-Data-Rate-Downstream AVP

The Access Line Actual-Data-Rate-Downstream AVP, Attribute Type 130,
contains the actual downstream train rate of a subscriber's
synchronized Access link.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Actual-Data-Rate-Downstream
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                      ... in bps (64 bits)                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Actual-Data-Rate-Downstream AVP contains an 8-octet unsigned
integer, indicating the subscriber's actual data rate downstream of a
synchronized Access link. The rate is coded in bits per second.

The Length (before hiding) of this AVP is 14.

5.5. Access Line Minimum-Data-Rate-Upstream AVP

The Access Line Minimum-Data-Rate-Upstream AVP, Attribute Type 131,
contains the subscriber's operator-configured minimum upstream data
rate.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Minimum-Data-Rate-Upstream
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                      ... in bps (64 bits)                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Minimum-Data-Rate-Upstream AVP contains an 8-octet unsigned
integer, indicating the subscriber's minimum upstream data rate (as
configured by the operator). The rate is coded in bits per second.

The Length (before hiding) of this AVP is 14.

5.6. Access Line Minimum-Data-Rate-Downstream AVP

The Access Line Minimum-Data-Rate-Downstream AVP, Attribute Type 132,
contains the subscriber's operator-configured minimum downstream data
rate.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Minimum-Data-Rate-Downstream
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                    ... in bps (64 bits)                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Minimum-Data-Rate-Downstream AVP contains an 8-octet unsigned
integer, indicating the subscriber's minimum downstream data rate (as
configured by the operator). The rate is coded in bits per second.

The Length (before hiding) of this AVP is 14.

5.7. Access Line Attainable-Data-Rate-Upstream AVP

The Access Line Attainable-Data-Rate-Upstream AVP, Attribute Type
133, contains the subscriber's actual attainable upstream data rate.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Attainable-Data-Rate-Upstream
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                    ... in bps (64 bits)                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Attainable-Data-Rate-Upstream AVP contains an 8-octet unsigned
integer, indicating the subscriber's Access Line actual attainable
upstream data rate. The rate is coded in bits per second.

The Length (before hiding) of this AVP is 14.

5.8. Access Line Attainable-Data-Rate-Downstream AVP

The Access Line Attainable-Data-Rate-Downstream AVP, Attribute Type
134, contains the subscriber's actual attainable downstream data
rate.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                 Attainable-Data-Rate-Downstream
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                       ... in bps (64 bits)                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Attainable-Data-Rate-Downstream AVP contains an 8-octet unsigned
integer, indicating the subscriber's Access Line actual DSL
attainable downstream data rate. The rate is coded in bits per
second.

The Length (before hiding) of this AVP is 14.

5.9. Access Line Maximum-Data-Rate-Upstream AVP

The Access Line Maximum-Data-Rate-Upstream AVP, Attribute Type 135,
contains the subscriber's maximum upstream data rate, as configured
by the operator.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                 Maximum-Data-Rate-Upstream
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                       ... in bps (64 bits)                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Maximum-Data-Rate-Upstream AVP contains an 8-octet unsigned
integer, indicating the numeric value of the subscriber's Access Line
maximum upstream data rate. The rate is coded in bits per second.

The Length (before hiding) of this AVP is 14.

5.10. Access Line Maximum-Data-Rate-Downstream AVP

The Access Line Maximum-Data-Rate-Downstream AVP, Attribute Type 136,
contains the subscriber's maximum downstream data rate, as configured
by the operator.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Maximum-Data-Rate-Downstream
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                   ... in bps (64 bits)                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Maximum-Data-Rate-Downstream AVP contains an 8-octet unsigned
integer, indicating the numeric value of the subscriber's Access Line
maximum downstream data rate. The rate is coded in bits per second.

The Length (before hiding) of this AVP is 14.

5.11. Access Line Minimum-Data-Rate-Upstream-Low-Power AVP

The Access Line Minimum-Data-Rate-Upstream-Low-Power AVP, Attribute
Type 137, contains the subscriber's minimum upstream data rate in low
power state, as configured by the operator.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            Minimum-Data-Rate-Upstream-Low-Power
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                   ... in bps (64 bits)                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Minimum-Data-Rate-Upstream-Low-Power AVP contains an 8-octet
unsigned integer, indicating the numeric value of the subscriber's
Access Line minimum upstream data rate when in low power state
(L1/L2). The rate is coded in bits per second.

The Length (before hiding) of this AVP is 14.

5.12. Access Line Minimum-Data-Rate-Downstream-Low-Power AVP

The Access Line Minimum-Data-Rate-Downstream-Low-Power AVP, Attribute
Type 138, contains the subscriber's minimum downstream data rate in
low power state, as configured by the operator.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Minimum-Data-Rate-Downstream-Low-Power
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                   ... in bps (64 bits)                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
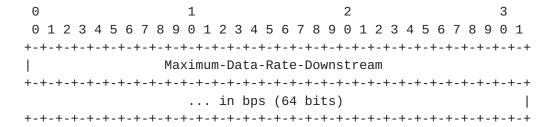
The Minimum-Data-Rate-Downstream-Low-Power AVP contains an 8-octet
unsigned integer, indicating the numeric value of the subscriber's
Access Line minimum downstream data rate when in low power state
(L1/L2). The rate is coded in bits per second.

The Length (before hiding) of this AVP is 14.

5.13. Access Line Maximum-Interleaving-Delay-Upstream AVP

The Access Line Maximum-Interleaving-Delay-Upstream AVP, Attribute
Type 139, contains the subscriber's maximum one-way upstream
interleaving delay, as configured by the operator.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           Maximum-Interleaving-Delay-Upstream             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Maximum-Interleaving-Delay-Upstream AVP contains a 4-octet
unsigned integer, indicating the numeric value in milliseconds of the
subscriber's Access Line maximum one-way upstream interleaving delay.

The Length (before hiding) of this AVP is 10.

5.14. Access Line Actual-Interleaving-Delay-Upstream AVP

The Access Line Actual-Interleaving-Delay-Upstream AVP, Attribute
Type 140, contains the subscriber's actual one-way upstream
interleaving delay.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Actual-Interleaving-Delay-Upstream               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Actual-Interleaving-Delay-Upstream AVP contains a 4-octet
unsigned integer, indicating the numeric value in milliseconds of the
subscriber's Access Line actual upstream interleaving delay.

The Length (before hiding) of this AVP is 10.

5.15. Access Line Maximum-Interleaving-Delay-Downstream AVP

The Access Line Maximum-Interleaving-Delay-Downstream AVP, Attribute
Type 141, contains the subscriber's maximum one-way downstream
interleaving delay, as configured by the operator.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            Maximum-Interleaving-Delay-Downstream              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

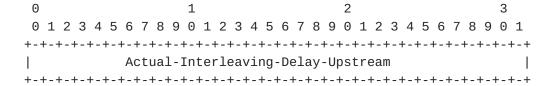The Maximum-Interleaving-Delay-Downstream AVP contains a 4-octet
unsigned integer, indicating the numeric value in milliseconds of the
subscriber's Access Line maximum one-way downstream interleaving
delay.

The Length (before hiding) of this AVP is 10.

5.16. Access Line Actual-Interleaving-Delay-Downstream AVP

The Access Line Actual-Interleaving-Delay-Downstream AVP, Attribute
Type 142, contains the subscriber's actual one-way downstream
interleaving delay.

The Attribute Value field for this AVP has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            Actual-Interleaving-Delay-Downstream              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
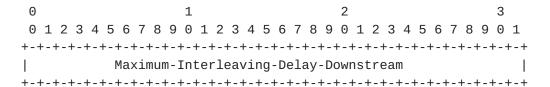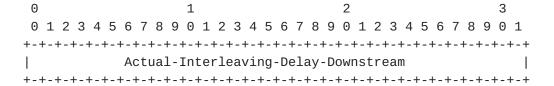
The Actual-Interleaving-Delay-Downstream AVP contains a 4-octet
unsigned integer, indicating the numeric value in milliseconds of the
subscriber's Access Line actual downstream interleaving delay.

The Length (before hiding) of this AVP is 10.

5.17. Access Line Access-Loop-Encapsulation AVP

The Access Line Access-Loop-Encapsulation AVP, Attribute Type 144,
describes the encapsulation(s) used by the subscriber on the access
loop.

The Length (before hiding) of this AVP is 9.

The Access-Loop-Encapsulation value is comprised of three 1-octet
values representing the Data Link, Encapsulation 1 and Encapsulation
2 respectively.

The Access-Loop-Encapsulation value is 3 octets in length, logically
divided into three 1-octet sub-fields, each containing its own
enumeration value, as shown in the following diagram:

```
         0                   1                   2
         0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
        +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
        |   Data Link   |    Encaps 1   |    Encaps 2   |
        +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Valid values for the sub-fields are as follows:

   Data Link

      0x00 ATM AAL5

      0x01 Ethernet

   Encaps 1

```
        0x00 NA - Not Available

        0x01 Untagged Ethernet

        0x02 Single-Tagged Ethernet

      Encaps 2

        0x00 NA - Not Available

        0x01 PPPoA LLC

        0x02 PPPoA Null

        0x03 IPoA LLC

        0x04 IPoA Null

        0x05 Ethernet over AAL5 LLC with FCS

        0x06 Ethernet over AAL5 LLC without FCS

        0x07 Ethernet over AAL5 Null with FCS

        0x08 Ethernet over AAL5 Null without FCS
```

5.18. ANCP Access Line Type AVP

   The ANCP Access Line Type AVP, Attribute Type 145, describes the
   transmission systems on access loop to the subscriber.

   The Attribute Value field for this AVP has the following format:

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                     ANCP-Access-Line-Type                     |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   The Length (before hiding) of this AVP is 10. The ANCP Access Line
   Type AVP defines the type of transmission system used.

   The ANCP Access Line Type AVP contains a 1-octet field encoding the
   Transmission System, followed by a 3-octet reserved field (MUST be
   zero), and is 4 octets in length. It indicates the transmission
   systems on access loop to the subscriber. The current valid values
   only utilize the single octet field.

   Valid values are as follows:

      Transmission system:

         0x01 ADSL1

         0x02 ADSL2

         0x03 ADSL2+

         0x04 VDSL1

         0x05 VDSL2

         0x06 SDSL

         0x07 UNKNOWN

5.19. Access Line IWF-Session AVP

   The Access Line IWF-Session AVP, Attribute Type 254, indicates if an
   Interworking Function has been performed with respect to the
   subscriber's session.

   The Attribute Value field for this AVP has the following format:

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                    Inter-Working Function                     |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   The Inter-Working Function is a 4-octet value.

      Valid values for this field are as follows:

         0x00 IWF not performed

         0x01 IWF performed

   The Length (before hiding) of this AVP is 10.

6. Connect Speed Update L2TP Attribute Value Pair Extensions

   The following sections define Connect Speed Update related AVPs.
   These AVPs (Section 6.1 and Section 6.2) use the IETF Vendor ID of 0.

The M bit for these AVPs SHOULD be set to 0. However, if it is
desired to prevent the establishment or tear down the established
L2TP session if the peer LNS does not support the Connect Speed
Update AVP extensions, the M bit MAY be set to 1. See Section 4.2 of
  [RFC2661] and Section 5.2 of [RFC3931].

6.1. Connect Speed Update AVP (CSUN, CSURQ)

The Connect Speed Update AVP, Attribute Type AVP-TBD1, contains the
updated connection speeds for this session. The format is consistent
with that of the Tx Connect Speed and Rx Connect Speed AVPs for
L2TPv2 (Attribute Types 24 and 38, respectively) and L2TPv3
(Attribute Types 74 and 75, respectively). Hence, there is a
separate format defined for L2TPv2 and L2TPv3.

The Attribute Value field for this AVP has the following format for
L2TPv2 Tunnels:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           Reserved            |       Remote Session Id       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|               Current Tx Connect Speed in bps                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|               Current Rx Connect Speed in bps                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Attribute Value field for this AVP has the following format for
L2TPv3 Tunnels:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Remote Session Id                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|               Current Tx Connect Speed in bps...              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          ...Current Tx Connect Speed in bps (64 bits)         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|               Current Rx Connect Speed in bps...              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          ...Current Rx Connect Speed in bps (64 bits)         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Remote Session Id is the remote session id relative to the sender
(i.e., the identifier that was assigned to this session by the peer).
The Current Tx Connect Speed is a 4-octet value (L2TPv2) or an

8-octet value (L2TPv3) representing the current transmit connect
speed, from the perspective of the LAC (e.g., data flowing from the
LAC to the remote system). The rate is encoded in bits per second.
The Current Rx Connect Speed is a 4-octet value (L2TPv2) or an
8-octet value (L2TPv3) representing the current receive connect
speed, from the perspective of the LAC (e.g., data flowing from the
remote system to the LAC). The rate is encoded in bits per second.

The Length (before hiding) of this AVP is 18 (L2TPv2) or 26 (L2TPv3).

6.2. Connect Speed Update Enable AVP (ICRQ)

The Connect Speed Update Enable AVP, Attribute Type AVP-TBD2,
indicates whether the LAC intends to send speed updates to the LNS
during the life of the session. The Connect Speed Update Enable AVP
is a boolean AVP. Presence of this AVP indicates that the LAC MAY
send speed updates using CSUN (see Section 4.1) during the life of
the session, and the LNS SHOULD query for the current connection
speed via the CSURQ (see Section 4.2) during failover
synchronization. Absence of this AVP indicates that the LAC will not
be sending speed updates using CSUN (see Section 4.1) during the life
of the session, and the LNS MUST NOT query for the current connection
speed via the CSURQ (see Section 4.2) during failover
synchronization.

The Length (before hiding) of this AVP is 6.

7. Access Line Information AVP Mapping

The Access Line information that is obtained from the Access Node/
DSLAM is required to be mapped into the Access Line AVPs. The Access
Line information can be obtained via:

o Vendor-Specific PPPoE Tags [RFC2516].

o DHCP Relay Options [RFC3046] and Vendor-Specific Information
   Suboptions [RFC4243].

o ANCP [I-D.ietf-ancp-protocol].

7.1. Summary of Access Line AVPs

Table 1 summarizes the Access Line AVPs defined in Section 5.1
through Section 5.19.

```
+-----------------+---------------------------------------+
| Access Line AVP | Name                                  |
+-----------------+---------------------------------------+
|        1 (0x01) | Agent-Circuit-Id                      |
|        2 (0x02) | Agent-Remote-Id                       |
|      129 (0x81) | Actual-Data-Rate-Upstream             |
|      130 (0x82) | Actual-Data-Rate-Downstream           |
|      131 (0x83) | Minimum-Data-Rate-Upstream            |
|      132 (0x84) | Minimum-Data-Rate-Downstream          |
|      133 (0x85) | Attainable-Data-Rate-Upstream         |
|      134 (0x86) | Attainable-Data-Rate-Downstream       |
|      135 (0x87) | Maximum-Data-Rate-Upstream            |
|      136 (0x88) | Maximum-Data-Rate-Downstream          |
|      137 (0x89) | Minimum-Data-Rate-Upstream-Low-Power  |
|      138 (0x8A) | Minimum-Data-Rate-Downstream-Low-Power |
|      139 (0x8B) | Maximum-Interleaving-Delay-Upstream   |
|      140 (0x8C) | Actual-Interleaving-Delay-Upstream    |
|      141 (0x8D) | Maximum-Interleaving-Delay-Downstream |
|      142 (0x8E) | Actual-Interleaving-Delay-Downstream  |
|      144 (0x90) | Access-Loop-Encapsulation             |
|      145 (0x91) | ANCP Access Line Type                 |
|      254 (0xFE) | IWF-Session                           |
+-----------------+---------------------------------------+
```

                    Table 1: Access Line AVP Summary

8. IANA Considerations

   Sections 8.1 and 8.2 describe request for new values in
   [IANA.l2tp-parameters], for registries already managed by IANA
   assignable through Expert Review according to [RFC3438]. Section 8.3
   describes number spaces not managed by IANA.

8.1. Message Type AVP Values

   This number space is managed by IANA as per [RFC3438]. There are two
   new message types, defined in Section 4.1 and Section 4.2, to be
   allocated for this specification.

      Message Type AVP (Attribute Type 0) Values

      MSG-TBD1: (CSUN) Connect-Speed-Update-Notification

      MSG-TBD2: (CSURQ) Connect-Speed-Update-Request

8.2. **Control Message Attribute Value Pairs (AVPs)**

   This number space is managed by IANA as per [RFC3438]. There are two
   new AVPs, defined in Section 6.1 and Section 6.2, to be allocated for
   this specification.

      Control Message Attribute Value Pairs (AVPs)

      AVP-TBD1: Connect Speed Update AVP

      AVP-TBD2: Connect Speed Update Enable AVP

8.3. **Values for Access Line Information AVPs**

   The Access Line Information AVPs use the Vendor ID of 3561 for the
   ADSL Forum (now Broadband Forum). The number spaces in these Values
   and their new allocations (e.g., enumerated values for the Access
   Line Access-Loop-Encapsulation AVP and ANCP Access Line Type AVP) are
   managed by the Broadband Forum.

9. **Security Considerations**

   The security of these AVP relies on an implied trust relationship
   between the Access Node/DSLAM and the BRAS/LAC, and between the LAC
   and the LNS. The identifiers which are inserted by the Access Node/
   DSLAM are unconditionally trusted; the BRAS does not perform any
   validity check on the information received before forwarding the
   information.

   These AVPs are intended to be used in environments in which the
   network infrastructure (the Access Node/DSLAM, the BRAS/LAC, the LNS,
   and the entire network in which those devices reside) is trusted and
   secure.

   Careful consideration should be given to the potential security
   vulnerabilities that are present in this model before deploying this
   option in actual networks.

   The AVPs described in this document are used to carry identification
   and characterization of subscriber Access Line, and to report
   connection speed changes. If used in a non-secure environment, they
   could reveal such information. The Tunnel (Control Connection)
   security considerations are covered in Section 9.1 of [RFC2661] and
   Section 8.l of [RFC3931]. Additionally, the hiding of AVP attribute
   values mechanism can be used to hide the value of the AVPs described
   in this document, if they are deemed sensitive in some environments.
   AVP hiding is described in Section 4.3 of [RFC2661] and Section 5.3

of [RFC3931].

The Attributes described in this document neither increase nor
decrease the security of the L2TP protocol.

It is possible to utilize [RFC3193] "Securing L2TP with IPsec" to
increase the security by utilizing IPsec to provide for tunnel
authentication, privacy protection, integrity checking and replay
protection.

10. Acknowledgements

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(previously the DSL Forum) Architecture and Transport Working Group
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11. References

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