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The Line Identification Destination Option
draft-ietf-6man-lineid-01

Abstract

In Ethernet based aggregation networks, several subscriber premises
may be logically connected to the same interface of an edge router.
This document proposes a method for the edge router to identify the
subscriber premises using the contents of the received Router
Solicitation messages. The applicability is limited to broadband
network deployment scenarios where multiple user ports are mapped to
the same virtual interface on the Edge Router.

Status of this Memo

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1. Introduction

Digital Subscriber Line (DSL) is a widely deployed access technology
for Broadband Access for Next Generation Networks. While
traditionally DSL access networks were Point-to-Point Protocol (PPP)
[RFC1661] based some networks are migrating from the traditional PPP
access model into a pure IP-based Ethernet aggregated access
environment. Architectural and topological models of an Ethernet
aggregation network in context of DSL aggregation are described in
[TR101].

```
+----+   +----+    +----------+
|Host|---| RG |----|          |
+----+   +----+    |          |
                   |    AN    |\
+----+   +----+    |          | \
|Host|---| RG |----|          |  \
+----+   +----+    +----------+   \                     +----------+
                                   \                    |          |
                           +-------------+              |          |
                           | Aggregation |              |  Edge    |
                           |   Network   |-------|  Router  |
                           +-------------+              |          |
                                 /                      |          |
                 +----------+   /                       +----------+
                 |          |  /
+----+   +----+  |          | /
|Host|---| RG |----|    AN   |/
+----+   +----+  |          |
                 |          |
                 +----------+
```
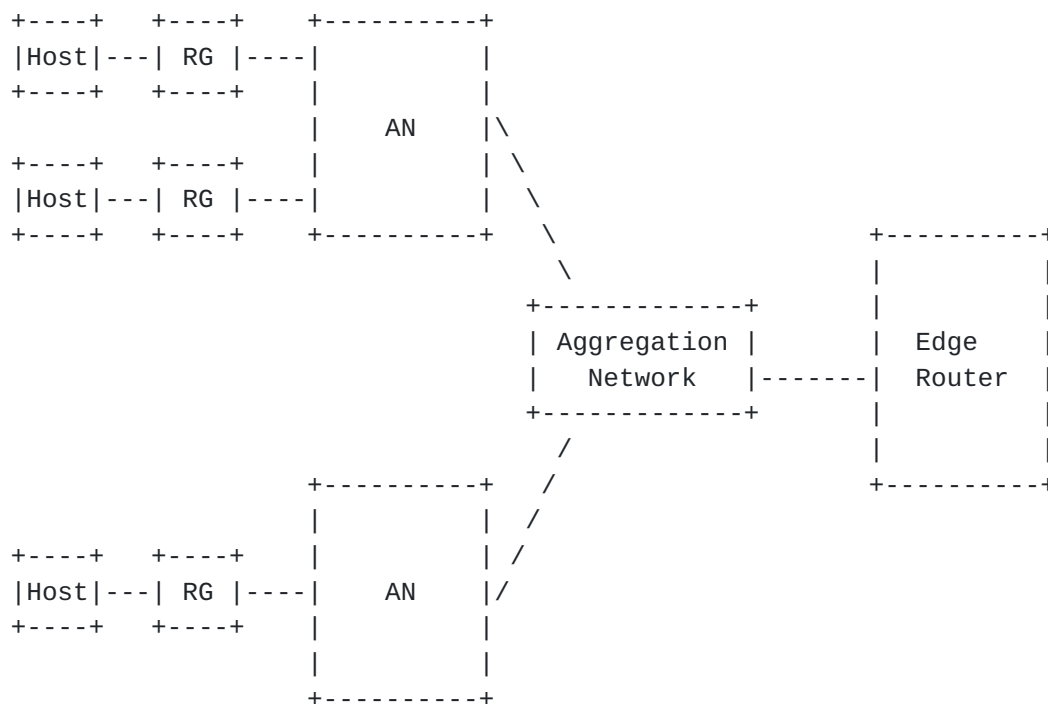
Figure 1: Broadband Forum Network Architecture

One of the Ethernet and GPON aggregation models specified in this
document bridges sessions from multiple user ports behind a DSL
Access Node (AN), also referred to as a Digital subscriber line
access multiplexer (DSLAM), into a single VLAN in the aggregation
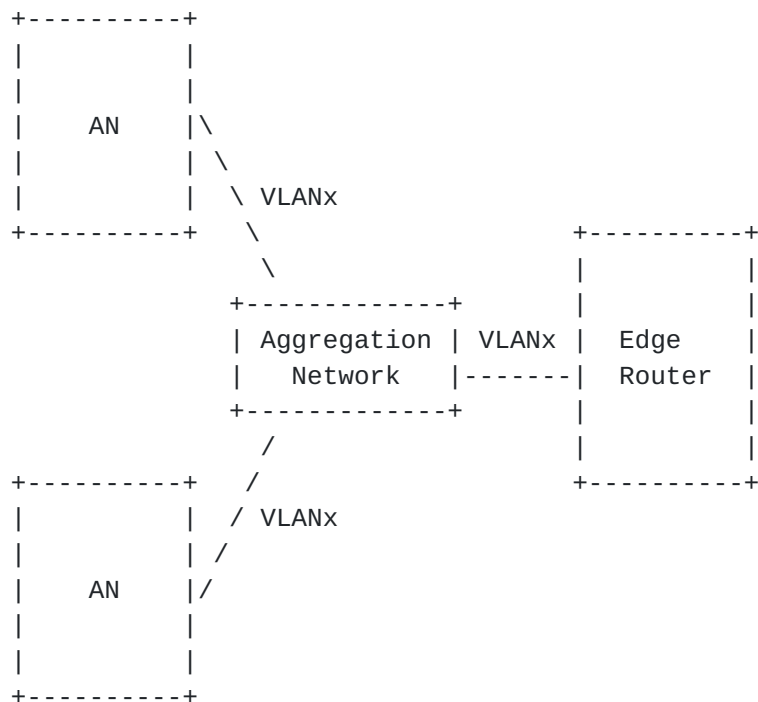network. This is called the N:1 VLAN allocation model.

```
    +----------+
    |          |
    |          |
    |    AN    |\
    |          | \
    |          |  \ VLANx
    +----------+   \                      +----------+
                    \                     |          |
               +-------------+            |          |
               | Aggregation | VLANx |  Edge     |
               |   Network   |-------|  Router   |
               +-------------+            |          |
                    /                     |          |
    +----------+   /                      +----------+
    |          |  / VLANx
    |          | /
    |    AN    |/
    |          |
    |          |
    +----------+
```

                      Figure 2: n:1 VLAN model

1.1. Terminology

   1:1 VLAN   It is a broadband network deployment
                           scenario where each user port is mapped to
                           a different VLAN on the Edge Router. The
                           uniqueness of the mapping is maintained in
                           the Access Node and across the Aggregation
                           Network.
   N:1 VLAN   It is a broadband network deployment
                           scenario where multiple user ports are
                           mapped to the same VLAN on the Edge Router.
                           The user ports may be located in the same
                           or different Access Nodes.
   AN   A DSL or a Gigabit Passive Optical Network
                           (GPON) Access Node. The Access Node
                           terminates the physical layer (e.g. DSL
                           termination function or GPON termination
                           function), may physically aggregate other
                           nodes implementing such functionality, or
                           may perform both functions at the same
                           time. This node contains at least one
                           standard Ethernet interface that serves as
                           its "northbound" interface into which it
                           aggregates traffic from several user ports
                           or Ethernet-based "southbound" interfaces.

                            It does not implement an IPv6 stack but
                            performs some limited inspection/
                            modification of IPv6 packets. The IPv6
                            functions required on the Access Node are
                            described in Section 5 of [TR177].
   Aggregation Network   The part of the network stretching from the
                            Access Nodes to the Edge Router. In the
                            context of this document the aggregation
                            network is considered to be Ethernet based,
                            providing standard Ethernet interfaces at
                            the edges, for connecting the Access Nodes
                            and Broadband Network. It is comprised of
                            ethernet switches that provide very limited
                            IP functionality (e.g. IGMP snooping, MLD
                            snooping etc.).
   Edge Router   The Edge Router, also known as the
                            Broadband Network Gateway (BNG) is the
                            first IPv6 hop for the user. In the cases
                            where the RG is bridged, the BNG acts as
                            the default router for the hosts behind the
                            RG. In cases where the RG is routed, the
                            BNG acts as the default router for the RG
                            itself. This node implements IPv6 router
                            functionality.
   GPON   Gigabit-capable Passive Optical Network is
                            an optical access network that has been
                            introduced into the Broadband Forum
                            architecture in [TR156]
   Host   A node that implements IPv6 host
                            functionality.
   RG   A residential gateway device. It can be a
                            Layer 3 (routed) device similar to one
                            specified in or a Layer 2 (bridged) device.
                            The residential gateway for Broadband Forum
                            networks is defined in [TR124]
   End-device   A node that sends Router Solicitations and
                            processes received Router Advertisements.
                            When a Layer 3 RG is used it is considered
                            an end-device in the context of this
                            document. When a Layer 2 RG is used, the
                            host behind the RG is considered to be an
                            end-device in the context of this document.

1.2. Conventions used in this document

   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. Issues with identifying the subscriber in an N:1 VLAN model

   In a DSL or GPON based fixed Broadband Network, IPv6 end-devices are
   connected to an Access Node (AN). These end-devices today will
   typically send a Router Solicitation Message to the Edge Router, to
   which the Edge Router responds with a Router Advertisement message.
   The Router Advertisement typically contains a prefix that the end-
   devices will use to automatically configure an IPv6 Address. Upon
   sending the Router Solicitation message the node connecting the end-
   device on the access circuit, typically an Access Node (AN), would
   forward the RS to the Edge Router upstream over a switched network.
   However, in such Ethernet-based aggregation networks, several
   subscriber premises may be connected to the same interface of an edge
   router (e.g. on the same VLAN). However, the edge router requires
   some information to identify the end-device on the circuit the end-
   device is connected on. To accomplish this, the AN needs to add line
   identification information to the Router Solicitation message and
   forward this to the Edge Router. This is analogous to the case where
   DHCP is being used, and the line identification information is
   inserted by a DHCP relay agent. This document proposes a method for
   the edge router to identify the subscriber premises using the
   contents of the received Router Solicitation messages.

3. Applicability

   The line identification destination option is intended to be used
   only for the N:1 VLAN deployment model. For the other VLAN
   deployment models line identification can be achieved differently.

4. Basic operation

   This document recommends tunneling Neighbor discovery packets inside
   another IPv6 packet that uses a destination option to convey line
   identification information. The Neighbor discovery packets are left
   unmodified inside the encapsulating IPv6 packet. In particular, the
   Hop Limit field of the ND message is not decremented when the packet
   is being tunneled. This is because ND messages whose Hop Limit is
   not 255 will be discarded by the receiver of such messages.

5. Access Node Behavior

5.1. On receiving a Router Solicitation from the end-device

   When an end-device sends out a Router Solicitation, it is received by
   the access node. The AN identifies these messages by looking for

ICMPv6 messages (IPv6 Next Header value of 58) with ICMPv6 type 133.
The AN intercepts and then tunnels the received Router Solicitation
in a newly created IPv6 datagram with the Line Identification Option
(LIO). The AN forms a new IPv6 datagram whose payload is the
received Router Solicitation message as described in [RFC2473] except
that the Hop Limit field of the Router Solicitation message MUST NOT
be decremented. If the AN has an IPv6 address, it SHOULD use this
address in the Source Address field of the outer IPv6 datagram.
Otherwise it MUST use the unspecified address as the Source Address
of the outer IPv6 datagram. The destination address of the outer
IPv6 datagram MUST be copied from the destination address of the
tunneled RS. The AN MUST insert a destination options header between
the outer IPv6 header and the payload. It MUST insert a LIO
destination option and set the line identification field of the
option to contain the circuit identifier corresponding to the logical
access loop port of the Access Node from which the RS was initiated.

5.2. On receiving a Router Advertisement from the Edge Router

When the edge router sends out a tunneled router advertisement in
response to the RS, it is received by the access node. If there is
an LIO option present, the AN MUST use the line identification data
of the LIO option to identify the subscriber agent circuit of the
Access Node on which the RA should be sent. The AN MUST then remove
the outer IPv6 header of this tunneled RA and multicast the inner
packet (the original RA) on this specific subscriber circuit.

5.2.1. Identifying tunneled Router Advertisements

The Access Node can identify tunneled RAs by installing filters based
on the destination address (All BBF Access Nodes) of the outer
packets, and the presence of a destination option header with an LIO
destination option.

5.3. On detecting a subscriber circuit coming up

RSs initiated by end-devices as described in Section 5.1 may be lost
due to lack of connectivity between the access node and the end-
device. To ensure that the end-device will receive an RA, the AN
needs to trigger the sending of periodic RAs on the edge router. For
this purpose, the AN needs to inform the edge router that a
subscriber circuit has come up. When the access node detects that a
subscriber circuit has come up, it MUST create a Router Solicitation
message as described in Section 6.3.7 of [RFC4861]. It MUST use the
unspecified address as the source address of this RS. It MUST then
tunnel this RS towards the edge router as described in Section 5.1.

In case there are connectivity issues between the AN and the edge

router, the RSes initiated by the AN can be lost. The AN MAY
continue retransmitting the Router Solicitations for a given LIO
until it receives an RA for that specific LIO.

Alternately, the AN can send this notification about the subscriber
circuit coming up using a out-of-band mechanism with acknowledgements
like ANCP, if such mechanism is available.

6. Edge Router Behavior

6.1. On receiving a Tunneled Router Solicitation from the Access Node

When the edge router receives a tunneled Router Solicitation
forwarded by the access node, it needs to check if there is an LIO
destination option present in the outer datagram. The edge router
can use the contents of the line identification field to lookup the
addressing information and policy that need to be applied to the line
from which the Router Solicitation was received. The edge router
MUST then process the inner RS message as specified in [RFC4861]

6.2. On sending a Router Advertisement towards the end-device

When the edge router sends out a Router Advertisement in response to
a tunneled RS that included an LIO option, it MUST tunnel the Router
Advertisement in a newly created IPv6 datagram with the Line
Identification Option (LIO). The edge router creates the Router
Advertisement message as described in Section 6.2.3 of [RFC4861].
The edge router may use the contents of the LIO in the received
router solicitation to determine the contents of this router
advertisement(es. The Edge Router then forms a new IPv6 datagram,
whose payload is the Router Advertisement message, as described in
[RFC2473] except that the Hop Limit field of the Router Advertisement
message MUST NOT be decremented. The Edge router MUST use a link-
local IPv6 address on the outgoing interface in the Source Address
field of the outer IPv6 datagram. The destination address of the
outer IPv6 datagram MUST be set to the well-known link-local scope
All BBF Access Nodes multicast address [to be allocated]. The edge
router MUST insert a destination options header between the outer
IPv6 header and the payload. It MUST insert a LIO destination option
and set the line identification field of the option to contain the
circuit identifier corresponding to the logical access loop port of
the Access Node to which the RA MUST be sent. The IPv6 destination
address of the inner RA MUST be set to the all-nodes multicast
address. The link-layer destination address of the tunneled RA MUST
be set to the unicast link-layer address of the Access Node that sent
the tunneled Router Solicitation which is being responded to.

**6.3. Sending periodic unsolicited Router Advertisements towards the
      end-device**

   After sending a tunneled Router Advertisement as specified in
   Section 6.2 in response to a received RS, the edge router MUST store
   the mapping between the LIO and the prefixes contained in the Router
   Advertisement. It should then initiate periodic sending of
   unsolicited Router Advertisements as described in Section 6.2.3. of
   [RFC4861] . The Router Advertisements MUST be created and tunneled
   as described in Section 6.2. The edge router MAY stop sending Router
   Advertisements if it receives a notification from the AN that the
   subscriber circuit has gone down. This notification can be received
   out-of-band using a mechanism such as ANCP.

7. Line Identification Destination Option (LIO)

   The Line Identification Destination Option (LIO) is a destination
   option that can be included in IPv6 datagrams that tunnel Router
   Solicitation and Router Advertisement messages. Multiple Line
   Identification destination options MUST NOT be present in the same
   IPv6 datagram. The LIO has an alignment requirement of (none).
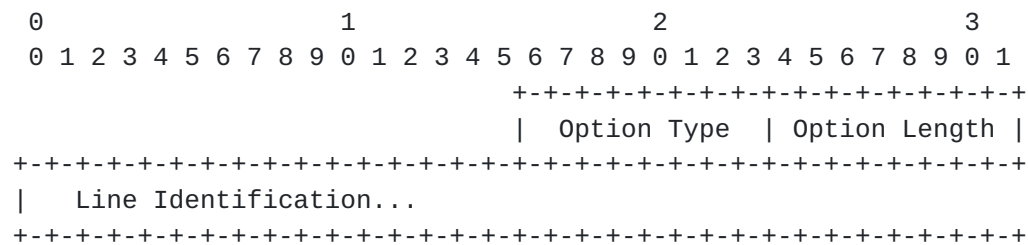
```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
                                +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                                | Option Type  | Option Length |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |   Line Identification...
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

          Figure 3: Line Identification Destination Option Layout

Option Type

> 8-bit identifier of the type of option. The option identifier
> for the line identification option will be allocated by the IANA.

Option Length

> 8-bit unsigned integer. The length of the option (excluding
> the Option Type and Option Length fields). The value 0 is
> considered invalid.

LineIDLen

> Length of the Line Identification field in number of octets.

Line Identification

> Variable length data inserted by the Access Node describing the
> subscriber agent circuit identifier corresponding to the logical
> access loop port of the Access Node from which the RS was
> initiated.

8. Interactions with Secure Neighbor Discovery

Since the SEND [RFC3971] protected RS/RA packets are not modified in
anyway by the mechanism described in this document, there are no
issues with SEND verification.

9. Acknowledgements

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and suggesting changes.

10. Security Considerations

The line identification information inserted by the access node or
the edge router is not protected. This means that this option may be
modified, inserted, or deleted without being detected. In order to
ensure validity of the contents of the line identification field, the
network between the access node and the edge router needs to be
trusted.

11. IANA Considerations

This document defines a new IPv6 destination option for carrying line
identification. IANA is requested to assign a new destination option
type in the Destination Options registry maintained at

http://www.iana.org/assignments/ipv6-parameters

<TBA1> Line Identification Option [RFCXXXX]

The act bits for this option need to be 10 and the chg bit needs to
be 0.

This document also requires the allocation of a well-known link-local
scope multicast address from the IPv6 Multicast Address Space
Registry located at

http://www.iana.org/assignments/ipv6-multicast-addresses/
ipv6-multicast-addresses.xml

<TBA2> All BBF Access Nodes [RFCXXXX]

12. Normative References

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