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Extensions to the PMIPv6 Access Network Identifier Option
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Abstract

   Access Network Identifier (ANI) Mobility option was introduced in
   [RFC6757] enabling a MAG to convey identifiers like network
   identifier, geolocation, and operator identifier. This specification
   extends the Access Network Identifier mobility option with sub-
   options to carry civic location and MAG group Identifier. This
   specification also defines a ANI Update timer sub-option that
   determines when and how often the ANI will be updated.

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1. Introduction

   [RFC6757] introduced the Access Network Identifier (ANI) mobility
   Option. This enabled a MAG to provide the Network Identifier,
   geolocation, and Operator-Identifier sub options. When the access
   network is WLAN, the Network Identifier sub option may contain SSID
   and BSSID of the Access Point (AP), the geolocation of the AP, and
   the Operator-Identifier may contain the realm of the operator
   managing the WLAN. The MAG sends the above information to the LMA.
   The LMA may use this information to determine access network specific
   policies (in terms of QoS, DPI, etc). Further, the LMA may make this
   information available to location based applications.

   While the above mentioned sub-options provide a rich set of
   information, in this document we describe the need for extending the
   ANI sub options, especially for WLAN deployments. In WLAN
   deployments (especially indoor AP deployments), it is difficult to
   provide Geo-spatial coordinates of APs. At the same time, for many
   location based applications the civic location is sufficient. This

motivates the need for a ANI civic location sub-option. In many
deployments, operators tend to create groups of APs into "AP-Groups".
These groups have a group identifier. The group-identifier is used
proxy for coarse location (such as floor of a building, or a small
building). The group identifier may also be used to provide a common
policy (e.g., QoS, charging, DPI) for all APs in that group. This
specification provides a sub-option for the MAG to convey a group-
identifier to the LMA. The provisioning of the group-identifier is
outside the scope of this specification and is typically done via a
configuration mechanism such as CLI (Command line Interface), CAPWAP
([RFC5415], [RFC5416]), etc. This document also provides a new sub-
option that determines how often the MAG will update the ANI. In
typical deployments, it is expected that the MAG will update the ANI
as soon as it changes. This is certainly true when the MAG is co-
located with the AP. When a client roams from one AP to another AP,
the MAG on the roamed (or sometimes referred to as the target) AP
will provide the new ANI (for example the network identifier and
geolocation of the new AP). However, if the MAG is co-located with
an Access Controller (also known as Wireless LAN Controller), then a
client roaming from one AP to another AP does not necessarily perform
an ANI update. This leads to stale ANI information at the LMA. To
cover the cases where ANI is always fresh or potentially "stale", we
introduce a new ANI Update Timer option. This enables the MAG to
inform the LMA when and how often the MAG will update the ANI. The
MAG sends an ANI update only if the ANI Update Timer has expired and
the ANI values have changed since the last ANI update. Consequently,
this enables the LMA to determine whether the ANI is stale or not and
when to expect an update. The LMA can use ANI update Timer option to
set the maximum frequency at which it wants to receive ANI updates.
This may be particularly useful in environments where a MAG covers a
large number of Wi-Fi APs and there is high client mobility between
the APs (for example in a stadium Wi-Fi deployment).

[RFC6757] provides ANI sub-options to carry geolocation information.
In this document we provide additional sub-options to carry civic
location, and group identifier. This document also defines an ANI
sub-option to enable a MAG to communicate how often the MAG will
update the ANI information.

2. Conventions and Terminology

2.1. Conventions

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 [RFC2119].

2.2. Terminology

   All the mobility related terms used in this document are to be
   interpreted as defined in [RFC5213] and [RFC5844].

3. Protocol Extension

3.1. Civic location Sub-Option

   The civic location is a mobility sub-option carried in the Access
   Network Identifier option defined in [RFC6757]. This sub-option
   carries the civic location information of the mobile node as known to
   the MAG. The format of this option is defined below.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| ANI Type=IANA |  ANI Length   |    Format     | Reserved      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            civic location                                    ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

                  Figure 1: Network-Identifier Sub-option

   ANI Type: <IANA-1>

   ANI Length: Total length of this sub option in octets, excluding the
      ANI Type and ANI length fields.

   Format: This specifies the encoding format of the civic location.
      Two values (0, and 1) are defined in this as specification as
      described below. The remaining values (2 through 255) are
      reserved.

         0: This value denotes Binary Encoding. The location format is
         based on the encoding format defined in Section 3.1 of
         [RFC4776], whereby the first 3 octets are not put into the
         civic location field (i.e., the code for the DHCP option, the
         length of the DHCP option, and the 'what' element are not
         included).

         1: This value denotes XML Encoding. [RFC5139] provides an XML
         format for representing the civic location. This is specified
         in the Presence Information Data Format Location Object.

civic location: This field will contain the civic location. The
   format (encoding) type is specified in the format field of this
   sub option. Note that the length shall not exceed 253 bytes.

3.2. MAG group identifier Sub-Option

The MAG group identifier is a mobility sub-option carried in the
Access Network Identifier option defined in [RFC6757]. The MAG group
identifier identifies the group affiliation of the MAG within that
Proxy Mobile IPv6 domain. The group identifier is not assumed to be
globally unique, across different network operators. However, group
identifier should be unique within an operator network. In domains
spanning multiple operators it is recommended that the operator
identifier sub-option (defined in [RFC6757]) be used in addition to
group identifier sub-option to ensure uniqueness. When the MAG is
configured with a group identifier, the MAG should send its group
identifier in the PBU. (The configuration of this identifier is
outside the scope of this specification. The usage of the identifier
by the LMA is left to implementation.) The format of this sub-option
is defined below.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| ANI Type=IANA |  ANI Length   |  group identifier             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

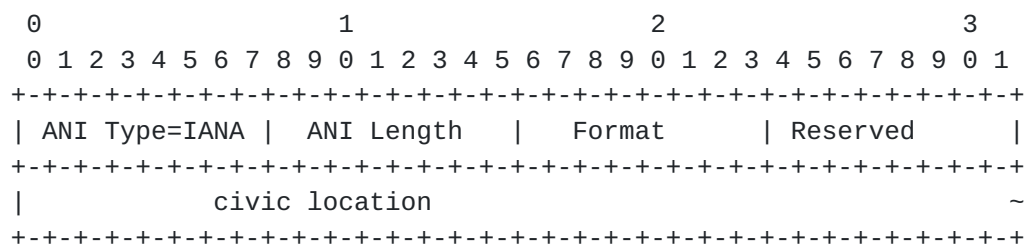Figure 2: MAG group identifier Sub-option

ANI Type: <IANA-2>

ANI Length: Total length of this sub option in octets, excluding the
   ANI Type and ANI length fields. The value is always 2.

group identifier: This is a 2 octet unsigned integer value assigned
   to a group of MAGs.

3.3. ANI Update-Timer Sub-Option

The ANI Update Timer is a mobility sub-option carried in the ANI
option defined in [RFC6757]. Section 4 describes how the MAG and LMA
use this sub option.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| ANI Type=IANA |  ANI Length   |        Update-Timer           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
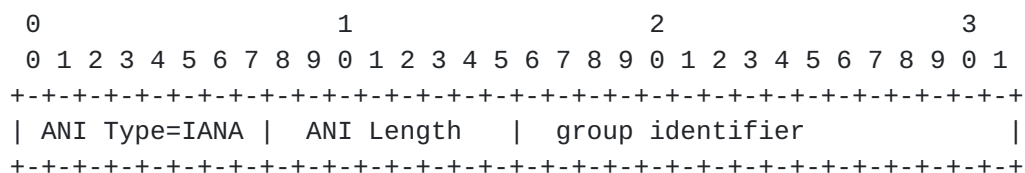
Figure 3: Network-Identifier Sub-option

ANI Type: <IANA-3>

ANI Length: Total length of this sub option in octets, excluding the
   ANI Type and ANI length fields is always 2.

Update-Timer: Update-Timer is a 16 bit unsigned integer. The unit
   of time is seconds. A value of 0 indicates that the MAG will send
   an updated ANI mobility option as soon as it discovers a change in
   ANI values. A non zero value indicates that the MAG may not send
   ANI values immediately after they have changed but rather send ANI
   updates only when the update timer expires.

4. Protocol Considerations

The following considerations apply to the LMA and the MAG.

4.1. MAG Considerations

o The conceptual Binding Update List entry data structure maintained
   by the mobile access gateway, described in Section 6.1 of
   [RFC5213], MUST be extended to store the access-network-related
   information elements associated with the current session.
   Specifically, the following parameters MUST be defined:

   * civic location

   * MAG group-identifier

   * ANI Update-Timer

o If the mobile access gateway is configured to support the Access
   Network Information sub-options defined in this specification, it
   SHOULD include this option with the specific sub-options in all
   Proxy Binding Update messages (including Proxy Binding Updates for
   lifetime extension and for deregistration) that it sends to the
   local mobility anchor. The Access Network Information option MUST
   be constructed as specified in Section 3. It SHOULD include the

ANI sub-option(s) that the mobile access gateway is configured to
carry in the Proxy Mobile IPv6 messages.

o ANI Update Timer Considerations: The MAG sets the Update-timer
   based on a exchange of timer values with the LMA. When the
   Update-Timer Sub option is carried in a PBU, it is considered as a
   proposed value for the Update-timer. The LMA may change the value
   of the Update-timer received in the PBU. When the LMA provided
   value for the Update-timer is different than what is sent by the
   MAG, the MAG should use the LMA provided value. If the MAG does
   not receive an Update-timer sub option in PBA (in response to
   sending the sub-option in the PBU), then MAG behavior is in
   accordance to [RFC6757]. When the Update-timer expires the MAG
   sends a PBU if and only if any ANI sub option has changed. If the
   MAG does not send a PBU, the update timer remains expired. If ANI
   sub options change and the Update-timer has already expired then
   the MAG shall send a PBU immediately. Note that the MAG may send
   a PBU even before the Update-Timer expires. This could be, for
   example, to initiate a QoS service request to the LMA (see
   [RFC7222]). In such cases, the MAG must reset the update timer
   when it sends a PBU.

o If the mobile access gateway had any of the Access Network
   Information mobility options included the Proxy Binding Update
   sent to a local mobility anchor, then the Proxy Binding
   Acknowledgement received from the local mobility anchor SHOULD
   contain the Access Network Information mobility option with the
   specific sub-options. If the mobile access gateway receives a
   Proxy Binding Acknowledgement with a successful Status Value but
   without an Access Network Information mobility option, then the
   mobile access gateway SHOULD log the event and, based on its local
   policy, MAY proceed to terminate the mobility session. In this
   case, the mobile access gateway knows the local mobility anchor
   does not understand the Access Network Information mobility option
   and therefore MAY consider it as a misconfiguration of the Proxy
   Mobile IPv6 domain.

4.2. LMA Considerations

o The conceptual Binding Cache entry data structure maintained by
   the local mobility anchor, described in Section 5.1 of [RFC5213],
   MUST be extended to store the access-network-related information
   elements associated with the current session. Specifically, the
   following parameters MUST be defined:

   * civic location

   * MAG group identifier

       * ANI Update-Timer

   o On receiving a Proxy Binding Update message from a MAG with the
      ANI option, the LMA must process the option and update the
      corresponding fields in the Binding Cache entry. If the option is
      not understood by that LMA implementation, it will skip the option
      and process the PBU without these options.

   o If the received Proxy Binding Update message does not include the
      Access Network Information option, then the mobility session
      associated with that Proxy Binding Update MUST be updated to
      remove any access network information elements.

   o If the local mobility anchor understands/supports the Access
      Network Identifier mobility sub-options defined in this
      specification, then the local mobility anchor MUST echo the Access
      Network Identifier mobility option with the specific sub-option(s)
      that it accepted back to the mobile access gateway in a Proxy
      Binding Acknowledgement. The civic location and group identifier
      sub-options defined in this specification MUST NOT be altered by
      the local mobility anchor. The LMA may change the value of the
      Update-Timer sub option. It may choose to either echo the same
      value, or increase or decrease the timer value. For example, if
      the LMA does not want to receive frequent updates (as implied by
      the timer value) it may choose to increase the value. Similarly,
      if the LMA needs to receive ANI updates as soon as possible then
      it may set the value to zero (0) in the PBA.

5. IANA Considerations

   This document requires the following IANA action.

   o Action-1: This specification defines a new Access Network
      Identifier sub-option called civic location Sub-option. This
      mobility sub-option is described in Section 3.1 and this sub-
      option can be carried in Access Network Identifier mobility
      option. The type value <IANA-1> for this sub-option needs to be
      allocated from the registry "Access Network Information (ANI) Sub-
      Option Type Values". RFC Editor: Please replace <IANA-1> in
      Section 3.1 with the assigned value, and update this section
      accordingly.

   o Action-2: This specification defines a new Access Network
      Identifier sub-option called MAG group identifier Sub-option.
      This mobility sub-option is described in Section 3.2 and this sub-
      option can be carried in Access Network Identifier mobility
      option. The type value <IANA-2> for this sub-option needs to be
      allocated from the registry "Access Network Information (ANI) Sub-

Option Type Values". RFC Editor: Please replace <IANA-2> in
Section 3.2 with the assigned value, and update this section
accordingly.

o Action-3: This specification defines a new Access Network
   Identifier sub-option called ANI-Update-Timer Sub-option. This
   sub-option is described in Section 3.3 and this sub-option can be
   carried in Access Network Identifier mobility option. The type
   value <IANA-3> for this sub-option needs to be allocated from the
   registry "Access Network Information (ANI) Sub-Option Type
   Values". RFC Editor: Please replace <IANA-3> in Section 3.3 with
   the assigned value, and update this section accordingly.

6. **Security Considerations**

The civic location sub-option defined in this specification is
carried in the Access Network Identifier option defined in [RFC6757].
This sub-option is carried in Proxy Binding Update and Proxy Binding
Acknowledgement messages. This sub-option is carried like any other
Access Network Identifier sub-option as defined in [RFC6757].
Therefore, it inherits from [RFC5213] and [RFC6757], its security
guidelines and does not require any additional security
considerations.

The civic location sub-option carried in the Access Network
Information option exposes the civic location of the network to which
the mobile node is attached. This information is considered to be
very sensitive, so care must be taken to secure the Proxy Mobile IPv6
signaling messages when carrying this sub-option. The base Proxy
Mobile IPv6 specification [RFC5213] specifies the use of IPSec for
securing the signaling messages, and those mechanisms can be enabled
for protecting this information. Operators can potentially apply
IPSec Encapsulating Security Payload (ESP) with confidentiality and
integrity protection for protecting the location information.

Access-network-specific information elements that the mobile access
gateway sends may have been dynamically learned over DHCP or using
other protocols. If proper security mechanisms are not in place, the
exchanged information between the MAG and LMA may be compromised.
This situation may result in incorrect service policy enforcement at
the local mobility anchor and impact to other services that depend on
this access network information. This threat can be mitigated by
ensuring the communication path between the mobile access gateway and
the access points is properly secured by the use of IPSec, Transport
Layer Security (TLS), or other security protocols.

7. Acknowledgements

   TBD

8. References

8.1. Normative References

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   [RFC7222]   Liebsch, M., Seite, P., Yokota, H., Korhonen, J., and S.
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8.2. Informative References

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