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Extensions to the Proxy Mobile IPv6 (PMIPv6) Access Network Identifier Option

Abstract

The Access Network Identifier (ANI) mobility option was introduced in RFC 6757, "Access Network Identifier (ANI) Option for Proxy Mobile IPv6". This enables a Mobile Access Gateway (MAG) to convey identifiers like the network identifier, geolocation, and operator identifier. This specification extends the Access Network Identifier mobility option with sub-options to carry the civic location and the MAG group identifier. This specification also defines an ANI Update-Timer sub-option that determines when and how often the ANI option will be updated.

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1. Introduction

"Access Network Identifier (ANI) Option for Proxy Mobile IPv6" [RFC6757] introduced the ANI mobility option. This enabled a Mobile Access Gateway (MAG) to provide the Network-Identifier, Geo-Location, and Operator-Identifier sub-options. When the access network is WLAN, the Network-Identifier sub-option may contain the Service Set Identifier (SSID) and the Basic Service Set Identifier (BSSID) of the Access Point (AP) and 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 Local Mobility Anchor (LMA). The LMA may use this information to determine access-network-specific policies (in terms of Quality of Service (QoS), Deep Packet Inspection (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 that are particularly useful in WLAN deployments. In WLAN deployments (especially indoor AP deployments), it is difficult to provide geospatial coordinates of APs. At the same time, for many location-based applications the civic location is sufficient. This motivates the need for an 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 as a proxy for coarse location (such as the 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) or via Control and Provisioning of Wireless Access Points (CAPWAP) [RFC5415] [RFC5416].

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 (WLC)), then a client roaming from one AP to another AP does not necessarily perform an ANI update. The WLC handles client mobility between APs and as a result, intra-WLC mobility is hidden from the LMA.

In such deployments, the information conveyed in the ANI sub-options (e.g., location) becomes stale and is only refreshed at the time of lifetime expiry. The MAG could deal with this by sending a Proxy Binding Update (PBU) whenever a client moves between APs just for the purpose of updating the ANI sub-option. Alternately, this document allows the LMA to determine how often it wants to know about the changes in the ANI sub-option; for example, in some cases the LMA may not care about the ANI sub-option except at the time of initial binding, or in some cases it may care about every AP transition. The sub-option allows the LMA to tell the MAG the desired update frequency. As always, mobility events or re-registration events will update the ANI sub-options. The LMA can use the ANI Update-Timer option to set the maximum frequency at which it wants to receive ANI updates. This is 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, if a LMA does not want ANI updates any more often than 100 seconds, then it can propose 100 seconds as the value for ANI Update-Timer.

[RFC6757] provides ANI sub-options to carry geolocation information. In this document, we provide additional sub-options to carry the 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 of the mobility-related terms used in this document are to be interpreted as defined in [RFC5213] and [RFC5844]. In this document, Civic Location is defined as follows.

Civic Location: There are two common ways to identify the location of an object, either through geospatial coordinates or by so-called civic addresses. Geospatial coordinates indicate longitude, latitude, and altitude, while civic addresses indicate a street address or sometimes the location within a building (such as a room number). Civic location refers to the civic address.

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.

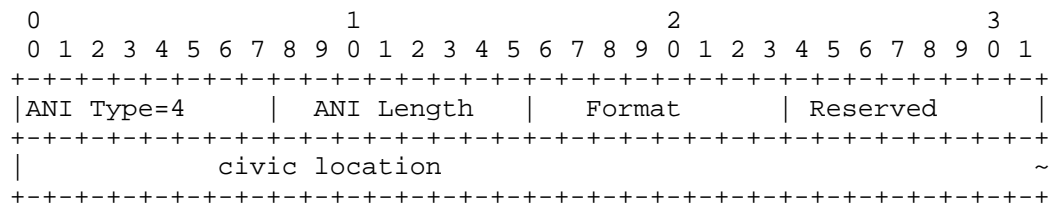


Figure 1: Civic-Location Sub-Option

ANI Type: 4

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. The value 0 is defined in this specification as described below. The remaining values (1 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). What is included is the two-octet country code field, followed by one or more civic address elements. The country-code is a two-letter ISO 3166 country code in capital ASCII letters, e.g., US. The structure of the civic address elements that follow the country code field is as defined in Section 3.3 of [RFC4776].

Reserved: This MUST be set to zero when sending and ignored when received.

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, the 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 the MAG-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. Note that 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=5      | ANI Length      | group identifier      |
+-----+-----+-----+-----+-----+-----+-----+-----+

```

Figure 2: MAG-Group-Identifier Sub-Option

ANI Type: 5

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 3-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=6      | ANI Length      | Update-Timer      |
+-----+-----+-----+-----+-----+-----+-----+-----+

```

Figure 3: ANI Update-Timer Sub-Option

ANI Type: 6

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

Update-Timer: Update-Timer is a 16-bit unsigned integer. The unit of time is 4 seconds (time unit of 4 seconds ensures consistency with the time units for the binding lifetime). 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 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], is extended to store the access-network-related information elements associated with the current session. Specifically, the following parameters are 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 includes this option with the specific sub-options in all PBU messages (including PBUs for lifetime extension and for deregistration) that it sends to the LMA. The Access Network Information option is constructed as specified in Section 3.
- o ANI Update-Timer Considerations: The MAG sets the Update-Timer based on an exchange of timer values with the LMA. When the ANI 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 ANI Update-Timer sub-option in the Proxy Binding Acknowledgement (PBA) (in response to sending the sub-option in

the PBU), then MAG behavior is in accordance to [RFC6757]. When ANI parameters of a mobility session change, the MAG checks whether the Update-Timer has expired. If the Update-Timer has expired, the MAG sends a PBU with the ANI option. The ANI option reflects the updated access network parameters for that mobility session. If the Update-Timer has not expired, the MAG does not send a PBU. When the Update-Timer for a mobility session expires, the MAG checks whether the ANI parameters have changed. If the parameters have changed from the last reported values, the MAG sends a PBU with an ANI option. If the parameters have not changed, the MAG does not send a PBU (and the Update-Timer remains expired). 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 in the PBU sent to an LMA, then the PBA received from the LMA should contain the Access Network Information mobility option with the specific sub-options. If the mobile access gateway receives a PBA with a successful Status Value but without an Access Network Information mobility option, then the mobile access gateway may log the event and, based on its local policy, even proceed to terminate the mobility session. In this case, the mobile access gateway knows the LMA does not understand the Access Network Information mobility option.

4.2. LMA Considerations

- o The conceptual Binding Cache entry data structure maintained by the LMA, described in Section 5.1 of [RFC5213], is extended to store the access-network-related information elements associated with the current session. Specifically, the following parameters are defined:
 - * civic location
 - * MAG group identifier
 - * ANI Update-Timer
- o On receiving a PBU 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 PBU message does not include the Access Network Information option, then the mobility session associated with that PBU is updated to remove any access network information elements.
- o If the LMA understands/supports the Access Network Identifier mobility sub-options defined in this specification, then the LMA echoes the Access Network Identifier mobility option with the specific sub-option(s) that it accepted back to the mobile access gateway in a PBA. The Civic-Location and MAG-Group-Identifier sub-options defined in this specification should not be altered by the LMA. The LMA may change the value of the ANI 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

IANA has registered the values described below.

- o This specification defines a new Access Network Identifier sub-option called the Civic-Location sub-option. This mobility sub-option is described in Section 3.1 and this sub-option can be carried in the Access Network Identifier mobility option. The type value <4> has been allocated from the registry "Access Network Information (ANI) Sub-Option Type Values".
- o This specification defines a new Access Network Identifier sub-option called the 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 <5> has been allocated from the registry "Access Network Information (ANI) Sub-Option Type Values".
- o This specification defines a new Access Network Identifier sub-option called the ANI Update-Timer sub-option. This sub-option is described in Section 3.3 and this sub-option can be carried in the Access Network Identifier mobility option. The type value <6> has been allocated from the registry "Access Network Information (ANI) Sub-Option Type Values".

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 PBU and PBA messages. This sub-option is carried like any other Access Network Identifier sub-option as defined in [RFC6757]. Therefore, it inherits its security guidelines from [RFC5213] and [RFC6757] and does not require any additional security considerations.

The Civic-Location sub-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. The other way to protect the sensitive location information of network users is of course to not send it in the first place. Users of the Civic-Location sub-option should provision location values with the highest possible level of granularity, e.g., to the province or city level rather than provisioning specific addresses.

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 LMA and impact 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. References

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