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Access Network Identifier (ANI) Option for Proxy Mobile IPv6

Abstract

The local mobility anchor in a Proxy Mobile IPv6 (PMIPv6) domain is able to provide access-network- and access-operator-specific handling or policing of the mobile node traffic using information about the access network to which the mobile node is attached. This specification defines a mechanism and a related mobility option for carrying the access network identifier and the access operator identification information from the mobile access gateway to the local mobility anchor over Proxy Mobile IPv6.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc6757.

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1. Introduction

Proxy Mobile IPv6 [RFC5213] can be used for supporting network-based mobility management in various types of network deployments. Network architectures such as service provider Wi-Fi access aggregation or Wireless Local Area Network (WLAN) integrated with mobile packet core are examples where Proxy Mobile IPv6 is a component of the overall architecture. Some of these architectures require the ability of the local mobility anchor (LMA) [RFC5213] to provide differentiated services and policing of traffic to the mobile nodes based on the access network to which they are attached. Policy systems in mobility architectures such as the Policy and Charging Control (PCC) Framework [TS23203] and the Access Network Discovery and Selection Function (ANDSF) [TS23402] in Third Generation Partnership Project (3GPP) systems allow configuration of policy rules with conditions based on the access network information. For example, the service treatment for the mobile node's traffic may be different when it is attached to an access network owned by the home operator than when owned by a roaming partner. The service treatment can also be different based on the configured Service Set Identifiers (SSIDs) in the case of access networks based on IEEE 802.11. Other examples of location services include the operator's ability to display a location-specific web page or apply tariff based on the location.

The Proxy Mobile IPv6 specification [RFC5213] requires the Access Technology Type (ATT) option to be carried from the mobile access gateway (MAG) to the local mobility anchor. This is a mandatory option. However, the Access Technology Type alone is not necessarily sufficient for a suitable policy to be applied at the local mobility anchor. Therefore, there is a need for additional access-network-related information to be available at the local mobility anchor. Learning the identity of the access network operator may not be possible for a local mobility anchor without the support of an additional policy framework that is able to provide required information out of band to the local mobility anchor. Such a policy framework may not be required for all Proxy Mobile IPv6 deployments; hence, an alternative approach for optionally carrying such information is required to ensure that additional information related to the access network is available.

This document defines a new mobility option, the Access Network Identifier (ANI) option, and its sub-options for Proxy Mobile IPv6, which can be used by the mobile access gateway to signal the access network information to the local mobility anchor. The specific details on how the local mobility anchor uses the information contained in the Access Network Identifier option are out of scope for this document. This information is intended for use between infrastructure nodes providing mobile management service and is not

exposed to outside entities, which ensures the location of the network to which the mobile node is attached, or any other access-network-specific information, is not revealed to other mobile nodes within the PMIPv6 domain or to other nodes outside the PMIPv6 domain. However, the location and access information MAY be exposed to specific parties outside the PMIPv6 domain based on an agreement approved by the subscriber; otherwise, this information MUST NOT be exposed in the absence of such agreements. If the location information is to be exposed outside the PMIPv6 domain, then that MUST be done using a Presence Information Data Format Location Object (PIDF-LO) [RFC5139] carrying the usage rules to which the subscriber has agreed. This mobility option is optional and is not mandatory for the Proxy Mobile IPv6 protocol. However, the Access Technology Type option continues to be a mandatory option and always needs to be carried in the Proxy Mobile IPv6 signaling messages.

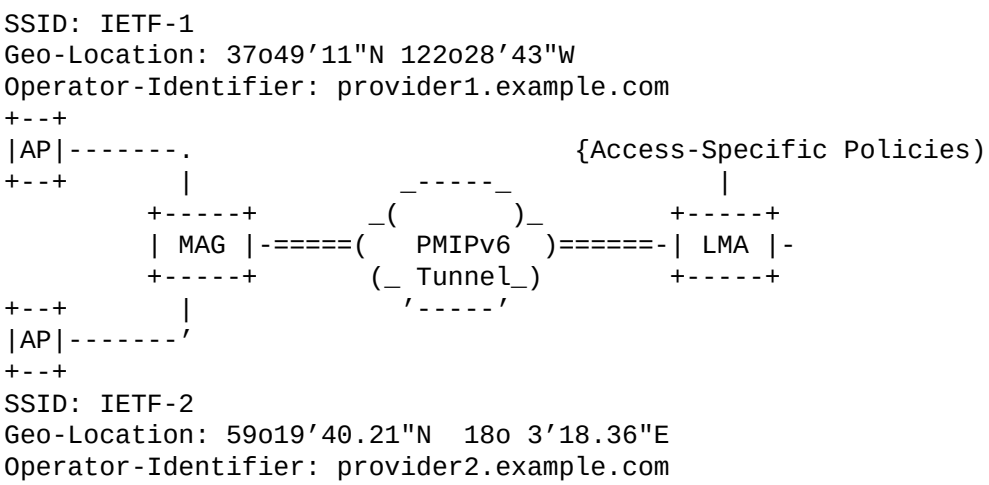

Figure 1: Access Networks Attached to MAG

Figure 1 illustrates an example Proxy Mobile IPv6 deployment where the mobile access gateway delivers the information elements related to the access network to the local mobility anchor over Proxy Mobile IPv6 signaling messages. In this example, the additional information could comprise the SSID of the used IEEE 802.11 network, the geo-location of the network to which the mobile node is attached, and the identities of the operators running the IEEE 802.11 access network infrastructure.

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 the Proxy Mobile IPv6 specifications [RFC5213] and [RFC5844]. Additionally, this document uses the following abbreviations:

Service Set Identifier

Service Set Identifier (SSID) identifies the name of the IEEE 802.11 network. SSID differentiates one network from the other.

Operator-Identifier

The Operator-Identifier is the Structure of Management Information (SMI) Network Management Private Enterprise Code of the IANA-maintained "Private Enterprise Numbers" registry [SMI]. It identifies the operator running the network attached to a specific interface of the mobile access gateway.

3. Access Network Identifier Option

The Access Network Identifier option is a mobility header option used to exchange information related to the access network between a local mobility anchor and a mobile access gateway. The option can be included in both Proxy Binding Update (PBU) and Proxy Binding Acknowledgement (PBA) messages, and there MUST NOT be more than a single instance of this mobility option in a mobility message. The Access Network Identifier mobility option MUST contain one or more Access Network Identifier sub-options. The Access Network Identifier sub-option is described in Section 3.1.

The alignment requirement for this option is 4n [RFC2460].

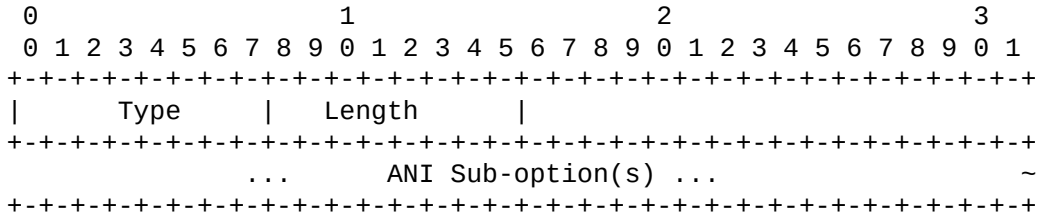

Figure 2: Access Network Identifier Option

Type: MUST be set to the value of 52, indicating that it is a Network-Identifier option.

Length: 8-bit unsigned integer indicating the length in octets of the option, excluding the Type and Length fields.

3.1. Format of the Access Network Identifier Sub-Option

The Access Network Identifier sub-options are used for carrying information elements related to the access network to which the mobile node is attached. These sub-options can be included in the Access Network Identifier option defined in Section 3. The format of this sub-option is as follows:

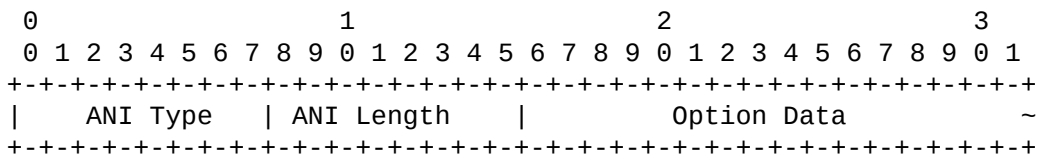

Figure 3: Access Network Identifier Sub-Option

ANI Type: 8-bit unsigned integer indicating the type of the Access Network Identifier sub-option. This specification defines the following types:

0 - Reserved

1 - Network-Identifier sub-option

2 - Geo-Location sub-option

3 - Operator-Identifier sub-option

ANI Length: 8-bit unsigned integer indicating the number of octets needed to encode the Option Data, excluding the ANI Type and ANI Length fields of the sub-option.

3.1.1. Network-Identifier Sub-Option

The Network-Identifier is a mobility sub-option carried in the Access Network Identifier option defined in Section 3. This sub-option carries the name of the access network (e.g., an SSID in the case of an IEEE 802.11 Access Network or a Public Land-based Mobile Network (PLMN) Identifier [TS23003] in the case of 3GPP access) to which the mobile node is attached. There MUST be no more than a single instance of this specific sub-option in any Access Network Identifier option. The format of this option is defined below.

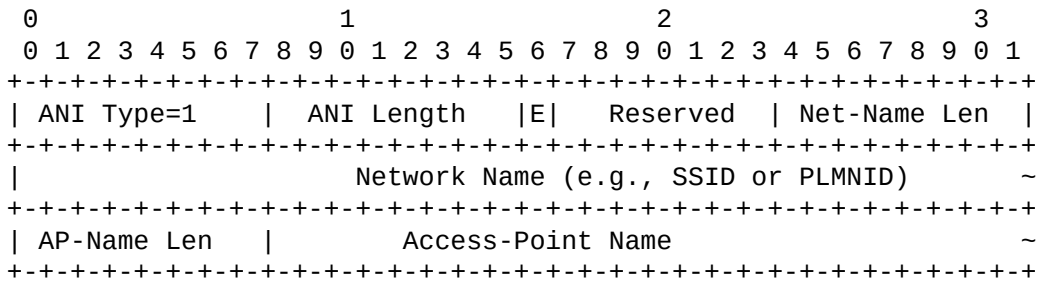

Figure 4: Network-Identifier Sub-Option

ANI Type: MUST be set to the value of (1), indicating that it is a Network-Identifier sub-option

ANI Length: Total length of this sub-option in octets, excluding the ANI Type and ANI Length fields. The value can be in the range of 5 to 32 octets.

E: 1-bit flag indicating whether the Network Name is encoded in UTF-8. If this flag is set to one (1), then the Network Name is encoded using UTF-8 [RFC3629]. If the flag is set to zero (0), this indicates that the encoding is undefined and is determined by out-of-band mechanisms. Implementations SHOULD use UTF-8 encoding.

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

Net-Name Length: 8-bit field for representing the length of the Network Name in octets. This field MUST NOT be set to zero.

Network Name: The name of the access network to which the mobile node is attached. The type of the Network Name is dependent on the access technology to which the mobile node is attached. If it is 802.11 access, the Network Name MUST be the SSID of the network. If the access network is 3GPP access, the Network Name is the PLMN Identifier of the network. If the access network is 3GPP2 access, the Network Name is the Access Network Identifier [ANI].

When encoding the PLMN Identifier, both the Mobile Network Code (MNC) [TS23003] and Mobile Country Code (MCC) [TS23003] MUST be 3 digits. If the MNC in use only has 2 digits, then it MUST be preceded with a '0'. Encoding MUST be UTF-8.

AP-Name Len: 8-bit field for representing the length of the Access-Point Name in octets. If the Access-Point Name is not included, then this length MUST be set to a value of zero.

Access-Point Name: The name of the access point (physical device name) to which the mobile node is attached. This is the identifier that uniquely identifies the access point. While Network Name (e.g., SSID) identifies the operator's access network, Access-Point Name identifies a specific network device in the network to which the mobile node is attached. In some deployments, the Access-Point Name can be set to the Media Access Control (MAC) address of the device or some unique identifier that can be used by the policy systems in the operator network to unambiguously identify the device. The string is carried in UTF-8 representation.

3.1.2. Geo-Location Sub-Option

The Geo-Location is a mobility sub-option carried in the Access Network Identifier option defined in Section 3. This sub-option carries the geo-location of the network to which the mobile node is attached, as known to the mobile access gateway. There MUST be no more than a single instance of this specific sub-option in any Access Network Identifier option. The format of this option is defined below and encodes the coordinates of an ellipsoid point. The format is based on the coordinate reference system specified in the World Geodetic System 1984 [WGS84].

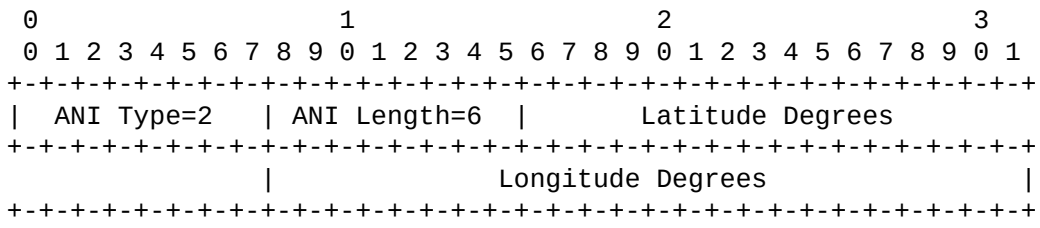

Figure 5: Geo-Location ANI Sub-Option

ANI Type: MUST be set to the value of (2), indicating that it is the Geo-Location sub-option

ANI Length: Total length of this sub-option in octets, excluding the ANI Type and ANI Length fields. It MUST be set to a value of (6).

Latitude Degrees: A 24-bit latitude degree value encoded as a two's complement, fixed point number with 9 whole bits. Positive degrees correspond to the Northern Hemisphere and negative degrees correspond to the Southern Hemisphere. The value ranges from -90 to +90 degrees.

Longitude Degrees: A 24-bit longitude degree value encoded as a two's complement, fixed point number with 9 whole bits. The value ranges from -180 to +180 degrees.

3.1.3. Operator-Identifier Sub-Option

The Operator-Identifier is a mobility sub-option carried in the Access Network Identifier option defined in Section 3. This sub-option carries the Operator-Identifier of the access network to which the mobile node is attached. There MUST be no more than a single instance of this specific sub-option in any Access Network Identifier option. The format of this option is defined below.

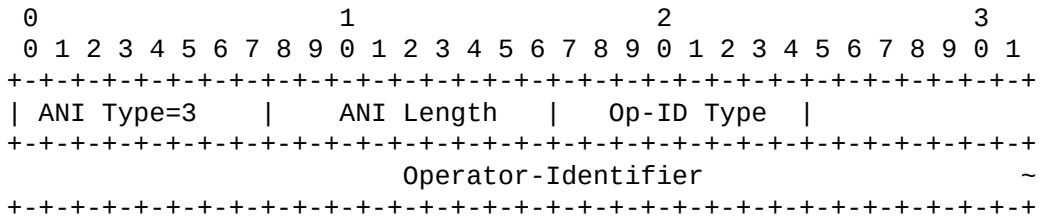

Figure 6: Operator-Identifier Sub-Option

ANI Type: It MUST be set to the value of (3), indicating that it is the Operator-Identifier sub-option

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

Operator-Identifier (Op-ID) Type: 8-bit unsigned integer indicating the type of the Operator-Identifier. Currently, the following types are defined:

0 - Reserved.

1 - Operator-Identifier as a variable-length Private Enterprise Number (PEN) [SMI] encoded in a network-byte order. The maximum PEN value depends on the ANI Length and is calculated using the formula: maximum PEN = 2^((ANI_length-1)*8)-1. For example, the ANI Length of 4 allows for encoding PENs from 0 to 2^24-1, i.e., from 0 to 16777215, and uses 3 octets of Operator-Identifier space.

2 - Realm of the operator. Realm names are required to be unique and are piggybacked on the administration of the DNS namespace. Realms meet the syntactic requirements of the "Preferred Name Syntax" defined in Section 2.3.1 of [RFC1035]. They are encoded as US-ASCII. 3GPP specifications also define realm names that can be used to convey PLMN Identifiers [TS23003].

Operator-Identifier: Up to 253 octets of the Operator-Identifier. The encoding of the identifier depends on the used Operator-Identifier Type. For Operator-Identifiers defined in this specification, the Operator-Identifier MUST NOT be empty.

4. Protocol Considerations

The following considerations apply to the local mobility anchor and the mobile access gateway.

4.1. Mobile Access Gateway 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:

Network-Identifier

Operator-Identifier

Geo-Location

- If the mobile access gateway is configured to support the Access Network Information option, 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.

- The access network information elements, such as Network-Identifier, Geo-Location, and Operator-Identifier, typically are statically configured on the mobile access gateway on a per-interface basis (for example, access point (AP-1) is attached through interface-1, and the SSID is X, Geo-Location is Y). In some deployments, this information can also be dynamically obtained, such as through DHCP Option (82), which is the DHCP Relay Agent Information option [RFC3046]. When the mobile node sends a DHCP Request, the access points typically add the SSID information to the Option 82 of the DHCP request, and when the mobile access gateway receives this request, it can parse the Option 82 of the DHCP request and obtain the SSID name. The mobility access gateway can also obtain this information from the DHCPv6 GeoLoc Option [RFC6225]. The specific details on how the mobile access gateway obtains these information elements are access technology and deployment specific and are outside the scope of this document. It is possible those information elements are configured on the MAG on a per-interface basis or dynamically obtained through some out-of-band means, such as based on the Control and Provisioning of Wireless Access Points (CAPWAP) protocol.

- If the protocol configuration variable EnableANISubOptNetworkIdentifier (Section 6) is set to a value of (1), the mobile access gateway SHOULD include the Network-Identifier sub-option in the Access Network Identifier option carried in the Proxy Binding Update. However, if the mobile access gateway is unable to obtain the Network-Identifier, then it MUST NOT include this sub-option. For including the Network-Identifier sub-option, the mobile access gateway needs to be aware of the Network Name of the access network (e.g., SSID in the case of a WLAN access network) to which the mobile node is attached.

This sub-option also includes the Access-Point Name for carrying the name of the access point to which the mobile node is attached. The Access-Point Name is specially important for applying location services, given that the Network Name (e.g., SSID) may not provide the needed uniqueness for identifying a location. When included, this sub-option MUST be constructed as described in Section 3.1.1

- If the protocol configuration variable EnableANISubOptGeoLocation (Section 6) is set to a value of (1), the mobile access gateway SHOULD include the Geo-Location sub-option in the Access Network Identifier option carried in the Proxy Binding Update. However, if the mobile access gateway is unable to obtain the Geo-location, then it MUST NOT include this sub-option. For including the Geo-Location sub-option, the mobile access gateway needs to be aware of the GPS coordinates of the network to which the mobile node is attached. When included, this sub-option MUST be constructed as described in Section 3.1.2.

- If the protocol configuration variable EnableANISubOptOperatorIdentifier (Section 6) is set to a value of (1), the mobile access gateway SHOULD include the Operator-Identifier sub-option in the Access Network Identifier option carried in the Proxy Binding Update. For including the Operator-Identifier sub-option, the mobile access gateway needs to be aware of the operator identity of that access network. The access network operator SHOULD obtain an identifier from the "Private Enterprise Number" registry, in order for the mobile access gateway to carry the Operator-Identifier. If a given access network operator has not obtained an identifier from the "Private Enterprise Number" registry or if the mobile access gateway is unable to learn the operator identity for any other administrative reasons, then it MUST NOT include this sub-option. When included, this sub-option MUST be constructed as described in Section 3.1.3.

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. Local Mobility Anchor Considerations

- 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:

  Network-Identifier

  Geo-Location

  Operator-Identifier

- On receiving a Proxy Binding Update message [RFC5213] from a mobile access gateway with the Access Network Information option, the local mobility anchor 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.

- If the local mobility anchor understands the Access Network Identifier mobility option received in a Proxy Binding Update and also supports the sub-option(s), 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 Access Network Identifier sub-options defined in this specification MUST NOT be altered by the local mobility anchor.

- 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.

- The local mobility anchor MAY choose to use the Access Network Information sub-options for applying any access-operator-specific handling or policing of the mobile node traffic. The specific details on how these sub-options are used is outside the scope of this document.

5. IANA Considerations

Per this document, the following IANA actions have been completed.

- Action 1: This specification defines a new mobility header option, the Access Network Identifier. This mobility option is described in Section 3. The type value (52) for this option has been assigned from the same numbering space as allocated for the other mobility options, as defined in [RFC6275].

- Action 2: This specification defines a new mobility sub-option format, the Access Network Information (ANI) sub-option. The format of this mobility sub-option is described in Section 3.1. This sub-option can be carried in the Access Network Information option. The type value for this sub-option is managed by IANA, under the registry "Access Network Information (ANI) Sub-Option Type Values". This specification reserves the following type values. Approval of new Access Network Information (ANI) sub-option type values are to be made through IANA Expert Review.

0	Reserved
1	Network-Identifier sub-option
2	Geo-Location sub-option
3	Operator-Identifier sub-option

- Action 3: This specification defines a new mobility sub-option, the Operator-Identifier sub-option. The format of this mobility sub-option is described in Section 3.1.3. The Operator-Identifier (Op-ID) Type field of this sub-option introduces a new number space. This number space is managed by IANA, under the registry "Operator-Identifier Type Registry". This specification reserves the following type values. Approval of new Operator-Identifier type values are to be made through IANA Expert Review.

0	Reserved
1	Operator-Identifier as a variable-length Private Enterprise Number (PEN)
2	Realm of the Operator

6. Protocol Configuration Variables

This specification defines the following configuration variables that control the use of sub-options related to the Access Network Information in Proxy Mobile IPv6 signaling messages. The mobility entities, local mobility anchor, and mobile access gateway MUST allow these variables to be configured by the system management. The configured values for these protocol variables MUST survive server reboots and service restarts.

EnableANISubOptNetworkIdentifier

This flag indicates the operational state of the Network-Identifier sub-option support. This configuration variable is available at both the mobile access gateway and the local mobility anchor. The default value for this flag is set to (0), indicating that support for the Network-Identifier sub-option is disabled.

When this flag on the mobile access gateway is set to a value of (1), the mobile access gateway SHOULD include this sub-option in the Proxy Binding Update messages that it sends to the local mobility anchor; otherwise, it SHOULD NOT include the sub-option. There can be situations where the mobile access gateway is unable to obtain the Network-Identifier and may not be able to construct this sub-option.

Similarly, when this flag on the local mobility anchor is set to a value of (1), the local mobility anchor SHOULD enable support for this sub-option; otherwise, it SHOULD ignore this sub-option.

EnableANISubOptGeoLocation

This flag indicates the operational state of the Geo-Location sub-option support. This configuration variable is available at both the mobile access gateway and the local mobility anchor. The default value for this flag is set to (0), indicating that support for the Geo-Location sub-option is disabled.

When this flag on the mobile access gateway is set to a value of (1), the mobile access gateway SHOULD include this sub-option in the Proxy Binding Update messages that it sends to the local mobility anchor; otherwise, it SHOULD NOT include the sub-option. There can be situations where the mobile access gateway is unable to obtain the geo-location information and may not be able to construct this sub-option.

Similarly, when this flag on the local mobility anchor is set to a value of (1), the local mobility anchor SHOULD enable support for this sub-option; otherwise, it SHOULD ignore this sub-option.

EnableANISubOptOperatorIdentifier

This flag indicates the operational state of the Operator-Identifier sub-option support. This configuration variable is available at both the mobile access gateway and the local mobility anchor. The default value for this flag is set to (0), indicating that support for the Operator-Identifier sub-option is disabled.

When this flag on the mobile access gateway is set to a value of (1), the mobile access gateway SHOULD include this sub-option in the Proxy Binding Update messages that it sends to the local mobility anchor; otherwise, it SHOULD NOT include the sub-option. There can be situations where the mobile access gateway is unable to obtain the Operator-Identifier information and may not be able to construct this sub-option.

Similarly, when this flag on the local mobility anchor is set to a value of (1), the local mobility anchor SHOULD enable support for this sub-option; otherwise, it SHOULD ignore this sub-option.

7. Security Considerations

The Access Network Information option defined in this specification is for use in Proxy Binding Update and Proxy Binding Acknowledgement messages. This option is carried like any other mobility header option as specified in [RFC6275] and does not require any special security considerations.

The Geo-Location sub-option carried in the Access Network Information option exposes the geo-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 may be potentially compromised with the mobile access gateway sending incorrect access network parameters to the

local mobility anchor. This situation may potentially 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.

8. Acknowledgements

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