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RADIUS Attribute for MAP

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Abstract

   Mapping of Address and Port (MAP) is a stateless mechanism for
   running IPv4 over IPv6-only infrastructure. It provides both IPv4 and
   IPv6 connectivity services simultaneously during the IPv4/IPv6 co-
   existing period. The Dynamic Host Configuration Protocol for IPv6
   (DHCPv6) MAP options has been defined to configure MAP Customer Edge
   (CE). However, in many networks, the configuration information may be
   stored in Authentication Authorization and Accounting (AAA) servers
   while user configuration is mainly from Broadband Network Gateway
   (BNG) through DHCPv6 protocol. This document defines a Remote
   Authentication Dial In User Service (RADIUS) attribute that carries
   MAP configuration information from AAA server to BNG. The MAP RADIUS
   attribute are designed following the simplify principle. It provides
   just enough information to form the correspondent DHCPv6 MAP option.

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[1](#). Introduction

Recently providers start to deploy IPv6 and consider how to transit to IPv6. Mapping of Address and Port (MAP) [[I-D.ietf-softwire-map](#)] is a stateless mechanism for running IPv4 over IPv6-only infrastructure. It provides both IPv4 and IPv6 connectivity services simultaneously during the IPv4/IPv6 co-existing period. MAP has adopted Dynamic Host Configuration Protocol for IPv6 (DHCPv6) [[RFC3315](#)] as auto-configuring protocol. The MAP Customer Edge (CE) uses the DHCPv6 extension options [[I-D.mdt-softwire-map-dhcp-option](#)] to discover MAP Border Relay (in tunnel model only) and to configure relevant MAP rules.

In many networks, user configuration information may be managed by AAA (Authentication, Authorization, and Accounting) servers. Current AAA servers communicate using the Remote Authentication Dial In User Service (RADIUS) [[RFC2865](#)] protocol. In a fixed line broadband network, the Broadband Network Gateways (BNGs) act as the access gateway of users. The BNGs are assumed to embed a DHCPv6 server function that allows them to locally handle any DHCPv6 requests issued by hosts.

Since the MAP configuration information is stored in AAA servers and user configuration is mainly through DHCPv6 protocol between BNGs and hosts/CEs, new RADIUS attributes are needed to propagate the information from AAA servers to BNGs. The MAP RADIUS attribute are designed following the simplify principle, while providing enough information to form the correspondent DHCPv6 MAP option. [[I-D.mdt-softwire-map-dhcp-option](#)].

[2](#). Terminology

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](#) [[RFC2119](#)].

The terms MAP CE and MAP Border Relay are defined in [[I-D.ietf-softwire-map](#)].

[3](#). MAP Configuration process with RADIUS

The below Figure 1 illustrates how the RADIUS protocol and DHCPv6 cooperate to provide MAP CE with MAP configuration information.
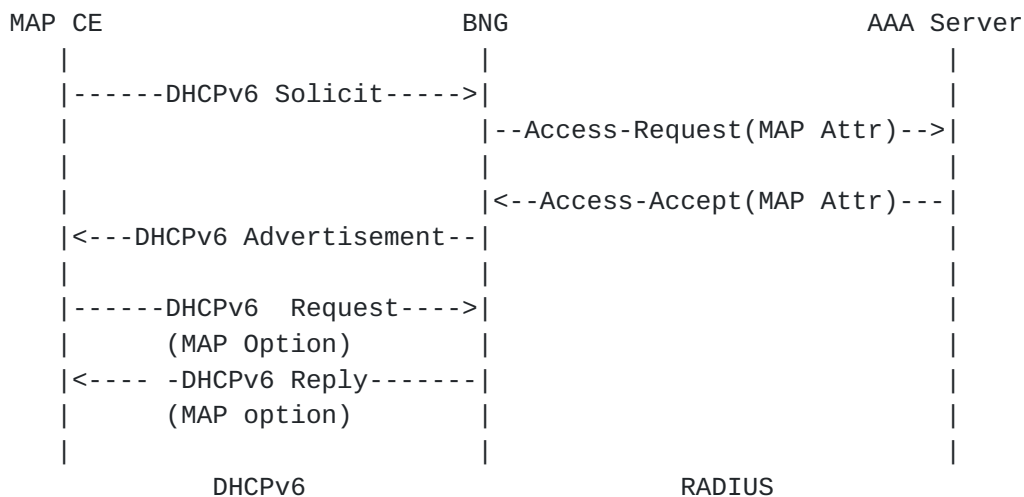
```
     MAP CE                         BNG                       AAA Server
        |                            |                             |
        |------DHCPv6 Solicit----->|                             |
        |                            |--Access-Request(MAP Attr)-->|
        |                            |                             |
        |                            |<--Access-Accept(MAP Attr)---|
        |<---DHCPv6 Advertisement--|                             |
        |                            |                             |
        |------DHCPv6  Request---->|                             |
        |      (MAP Option)          |                             |
        |<---- -DHCPv6 Reply-------|                             |
        |      (MAP option)          |                             |
        |                            |                             |
                   DHCPv6                        RADIUS
           Figure 1: the cooperation between DHCPv6 and RADIUS
```

BNGs act as a client of RADIUS and as a DHCPv6 server for DHCPv6
protocol. First, a BNG receives a DHCPv6 Solicit message from the MAP
CE. It initiates the BNG to request correspondent user authentication
relevant from an AAA server using RADIUS protocol. A MAP
configuration request may also be sent in the same message. If the
user authentication is approved by the AAA server, an Access-Accept
message is acknowledged with the IPv6-MAP-Configuration Attribute,
defined in the next Section. After the BNG responds to the user with
an Advertisement message, the user requests for a MAP Option. Then,
the BNG can reply the user using the DHCPv6 protocol.

In the abovementioned scenario, the Access-Request packet contains a
Service-Type attribute with the value Authorize Only (17), thus
according to [RFC5080] the Access-Request packet MUST contain a State
attribute.

Figure 2 describes another scenario, in which the authentication
operation is not coupled with DHCPv6. In the authentication stage,
which may be initiated by other user behavior, such as PPP dial-up,
the BNG obtains the MAP configuration information from the AAA server
through the RADIUS protocol. When the user requests the MAP Option,
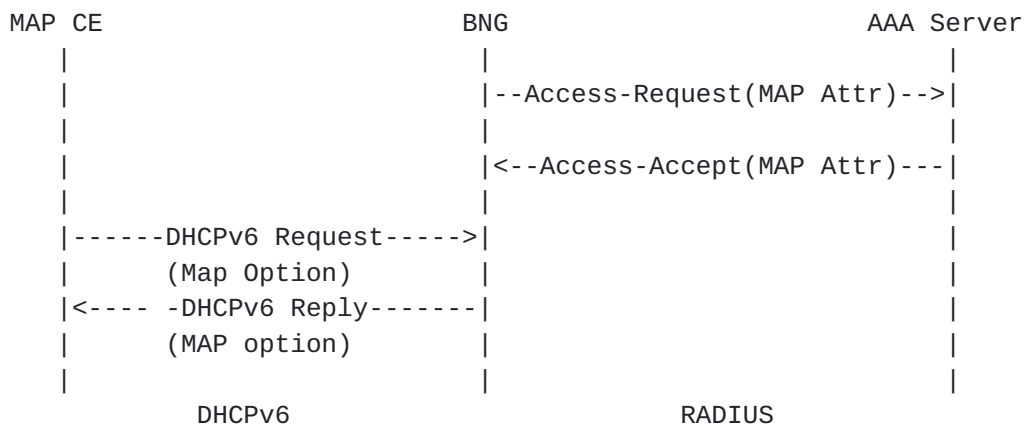the BNG replies with a MAP option in DHCPv6 Reply message.

```
      MAP CE                        BNG                    AAA Server
        |                           |                          |
        |                           |--Access-Request(MAP Attr)-->|
        |                           |                          |
        |                           |<--Access-Accept(MAP Attr)---|
        |                           |                          |
        |------DHCPv6 Request----->|                          |
        |       (Map Option)        |                          |
        |<---- -DHCPv6 Reply-------|                          |
        |       (MAP option)        |                          |
        |                           |                          |
                  DHCPv6                        RADIUS
              Figure 2: the cooperation between DHCPv6 and RADIUS
```

   After receiving the IPv6-MAP-Configuration Attribute in the initial
   Access-Accept, the BNG MUST store the received MAP configuration
   parameters locally. When the MAP CE sends a DHCPv6 Request message to
   request an extension of the lifetimes for the assigned address, the
   BNG does not have to initiate a new Access-Request towards the AAA
   server to request the MAP configuration parameters. The BNG retrieves
   the previously stored MAP configuration parameters and use them in
   its reply.

   If the DHCPv6 server to which the DHCPv6 Request message was sent at
   time T1 has not responded, the DHCPv6 client enters the Rebind state
   and attempts to contact any server. In this scenario the BNG
   receiving the DHCPv6 message MUST initiate a new Access-Request
   towards the AAA server. The BNG MAY include the IPv6-MAP-
   Configuration Attribute in its Access-Request. If the BNG does not
   receive the IPv6-MAP-Configuration Attribute in the Access-Accept it
   MAY fallback to a pre-configured default MAP configuration, if any.

4. Attributes

   This section defines IPv6-MAP-Rule Attribute which is used in the MAP
   scenario. The attribute design follows [RFC6158].

   The MAP RADIUS attribute are designed following the simplify
   principle. The sub options are organized into two categories: the
   necessary and the optional.

4.1. IPv6-MAP-Configuration Attribute

   The IPv6-MAP-Configuration Attribute is structured 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |    Length     |                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               +
|                                                               |
+                         Rule Option(s)                        +
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Type

   TBD

Length

   2 + the length of the Rule option(s)

Sub Option

   a variable field that may contains one or more Rule option(s),
   defined in Section 4.2.

4.2. IPv6 MAP Options

Depending on deployment scenario, one Default Mapping rule and zero
or more other type Mapping Rules MUST be included in one IPv6-MAP-
Configuration Attribute.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |    Length     |                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               +
|                                                               |
+                         Sub Options                           +
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Type

   1 Default Mapping Rule

   2 Basic Mapping Rule (Not Forwarding Mapping Rule)

   3 Forwarding Mapping Rule (Not Basic Mapping Rule)

4 Basic & Forwarding Mapping Rule

Length

2 + the length of the sub options

Sub Option

a variable field that contains necessary sub options defined in
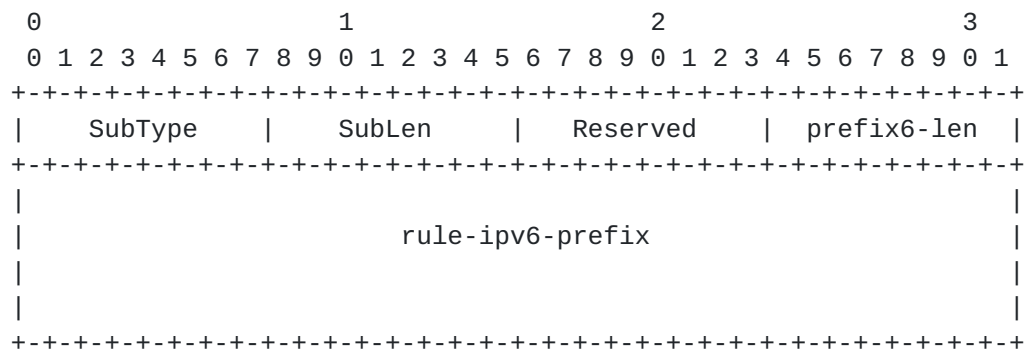Section 4.3 and zero or several optional sub options, defined
in Section 4.4.

4.3. Sub Options for MAP Rule Option

Different from [I-D.mdt-softwire-map-dhcp-option], EA-Len, Embedded-
Address (EA) length, is not present at all, because it can be
calculated by the combine of prefix4len, prefix6-len, excluded ports
and off bits.

4.3.1. Rule-IPv6-Prefix Sub Option

The Rule-IPv6-Prefix Sub Option is necessary for every MAP Rule
option. It should appear for once and only once.

The IPv6 Prefix sub option is follow the framed IPv6 prefix designed
in [RFC3162].

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    SubType    |    SubLen     |   Reserved    |  prefix6-len  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
|                      rule-ipv6-prefix                         |
|                                                               |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

SubType

1 (SubType number, for the Rule-IPv6-Prefix6 sub option)

SubLen

20 (the length of the Rule-IPv6-Prefix6 sub option)

Reserved

Reserved for future usage. It should be set to all zero.

prefix6-len

length of the IPv6 prefix, specified in the rule-ipv6-prefix
field, expressed in bits

rule-ipv6-prefix

a 128-bits field that specifies an IPv6 prefix that appears in
a MAP rule

"For the encapsulation mode the Rule IPv6 prefix can be the full IPv6
address of the BR." [I-D.ietf-softwire-map]

4.3.2. Rule-IPv4-Prefix 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    SubType    |    SubLen     |   Reserved    |  prefix4-len  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       rule-ipv4-prefix                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

SubType

2 (SubType number, for the Rule-IPv4-Prefix6 sub option)

SubLen

8 (the length of the Rule-IPv4-Prefix6 sub option)

Reserved

Reserved for future usage. It should be set to all zero.

Prefix4-len

length of the IPv6 prefix, specified in the rule-ipv6-prefix
field, expressed in bits

rule-ipv4-prefix

a 32-bits field that specifies an IPv4 prefix that appears in
a MAP rule

4.3.3. Encapsulation/Translation Flag Sub Option

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    SubType    |    SubLen    |    E/T Flag   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

        SubType

            3 (SubType number, for the rule-id sub option)

        SubLen

            3 (the length of the rule-id sub option)

        E/T Flag

            indicate the MAP transport mode: encapsulation or translation.
            all 0 for encapsulation, all 1 for translation.

    If this sub option is not present, the following default values are
    to be assumed: encapsulation mode.

4.3.4. Map Port Parameter 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    SubType    |    SubLen    |  rsv |offset | rsv | PSID-len|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           PSID           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

        SubType

            4 (SubType number, for the Map port parameter sub option)

        SubLen

            6 (the length of the Map port parameter sub option)

        Reserved

            Reserved for future usage. It should be set to all zero.

        PSID (Port-set ID) Offset

        4 bits long field that specifies the numeric value for the MAP
        algorithm's excluded port range/offset bits (A-bits), as per
        section 5.1.1 in [I-D.ietf-softwire-map]. Default must be set
        to 4.

    PSID-len

        Bit length value of the number of significant bits in the PSID
        field. (also known as 'k'). When set to 0, the PSID field is to
        be ignored. After the first 'a' bits, there are k bits in the
        port number representing valid of PSID. Subsequently, the
        address sharing ratio would be 2 ^k.

    PSID
        Explicit 16-bit (unsigned word) PSID value. The PSID value
        algorithmically identifies a set of ports assigned to a CE. The
        first k-bits on the left of this 2-octets field is the PSID
        value. The remaining (16-k) bits on the right are padding zeros.

4.4. Table of attributes

   The following table provides a guide to which attributes may be found
   in which kinds of packets, and in what quantity.

Request	Accept	Reject	Challenge	Accounting Request	#	Attribute
0-1	0-1	0	0	0-1	TBD1	IPv6-MAP-Configuration

   The following table defines the meaning of the above table entries.

   0   This attribute MUST NOT be present in packet.
   0+   Zero or more instances of this attribute MAY be present in
          packet.
   0-1   Zero or one instance of this attribute MAY be present in
          packet.
   1   Exactly one instance of this attribute MUST be present in
          packet.

5. Diameter Considerations

   This attribute is usable within either RADIUS or Diameter [RFC3588].
   Since the Attributes defined in this document will be allocated from
   the standard RADIUS type space, no special handling is required by
   Diameter entities.

6. Security Considerations

Known security vulnerabilities of the RADIUS protocol are discussed in RFC 2607 [RFC2607], RFC 2865 [RFC2865], and RFC 2869 [RFC2869]. Use of IPsec [RFC4301] for providing security when RADIUS is carried in IPv6 is discussed in RFC 3162 [RFC3162].

Security considerations for the Diameter protocol are discussed in RFC 3588 [RFC3588].

7. IANA Considerations

This document requires the assignment of two new RADIUS Attributes Types in the "Radius Types" registry (currently located at http://www.iana.org/assignments/radius-types for the following attributes:

o IPv6-MAP-Configuration   TBD1

IANA should allocate the numbers from the standard RADIUS Attributes space using the "IETF Review" policy [RFC5226].

8. Acknowledgments

The authors would like to thank for valuable comments.

9. References

9.1. Normative References

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             T. Mrugalski, et al., "DHCPv6 Options for Mapping of
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9.2. Informative References

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