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        Dynamic Host Configuration Protocol (DHCPv6) Options for Shared IP
                              Addresses Solutions
                draft-boucadair-dhcpv6-shared-address-option-01

Abstract

   This memo defines Dynamic Host Configuration Protocol version 6
   (DHCPv6) Options to be used in the context of shared IP address
   solutions. In some deployment scenarios, DHCP (IPv4) cannot be used
   to configure customer devices because only IPv6 capabilities are
   deployed (e.g., DS-lite context or IPv6 Port Range). Therefore,
   DHCPv6 may be used to convey IPv4-related configuration information
   such as Port Range and/or Port Extended IPv4 addresses. This
   document defines also a DHCPv6 Option aiming to convey the IPv6
   prefix to be used to build IPv4 Embedded IPv6 addresses
   [I-D.ietf-behave-address-format].

Requirements Language

   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].

Status of this Memo

   This Internet-Draft is submitted to IETF in full conformance with the
   provisions of BCP 78 and BCP 79.

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Table of Contents

1. Introduction

   Within the context of IPv4 address depletion, several solutions have
   been submitted to the IETF to propose viable alternatives to double
   NAT [I-D.nishitani-cgn]. Examples of these solutions are
   [I-D.ietf-softwire-dual-stack-lite] and
   [I-D.boucadair-behave-ipv6-portrange]. These solutions propose to
   share a given global IPv4 address between several customers. These
   solutions differ in the way they behave and particularly on the
   location of the NAT function. In
   [I-D.boucadair-behave-ipv6-portrange] the NAT function stays at the
   CPE level and none lies in the network whilst in
   [I-D.ietf-softwire-dual-stack-lite] the NAT function is located in
   the network -in the DS-lite node- while the NAT in the CPE can be
   deactivated. Nevertheless, [I-D.ietf-softwire-dual-stack-lite]
   supports the Extended Port IP address logic mainly for the
   enforcement of port forwarding service for instance. Therefore,
   dedicated means such as [I-D.bajko-pripaddrassign] are required for
   the provisioning of pertinent information to constrain the source
   port number. [I-D.bajko-pripaddrassign] specifications may be used
   when IPv4-enabled DHCP servers are deployed and corresponding DHCP
   clients enabled in customer devices, such as the CPE.

   Furthermore, both [I-D.ietf-softwire-dual-stack-lite] and
   [I-D.boucadair-behave-ipv6-portrange] assume that only IPv6 transfer
   capabilities are activated on the link connecting the customer's
   device to the access network. IPv4-in-IPv6 tunneling capabilities
   can be put in place to allow DHCP exchanges and therefore
   [I-D.bajko-pripaddrassign] can be used to provision the customer

device. Nevertheless, in environments where no IPv4-enabled DHCP
servers are maintained or no tunneling means are deployed to reach
DHCP servers, alternative means to provision the customer's device
are required. This memo is an effort to meet this requirement.

Note that [I-D.dhankins-softwire-tunnel-option] can be used to
provide the customer device with the IPv6 address of a DS-lite CGN or
a PRR (Port Range Router) node.

Concretely, this document defines the following new DHCPv6 Options
[RFC3315]:

1.   IPv4 address: This option is used to convey a "full" IPv4
     address.

2.   Port Extended IPv4 Address: This option carries an IPv4 address
     to be used in conjunction with an allocated Port Range. In case
     of Port Range allocation, several customers are assigned with the
     same IPv4 Address. This option defines the allowed port values

     to be used as source port number. This option is completely
     independent of the IPv4 address Option above.

3.   IPv4-embedded IPv6 address Format: This option is used to provide
     the device with the prefix to be used to build an IPv4-embedded
     IPv6 address, see for intance [I-D.ietf-behave-address-format].

4.   Supported IPv4-embedded IPv6 address Formats: This option allows
     a DHCPv6 client to indicate the type of IPv4-embedded IPv6
     address format(s) it can handle.

2. IPv4 Address Option

   This DHCPv6 Option carries an IPv4 address. The DHCPv6 Option has
   the format shown in Figure 1 :

```
        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_IPV4_A          |          option-length        |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |                     IP Address (IPv4 Address)                 |
```

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       preferred-lifetime                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        valid-lifetime                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
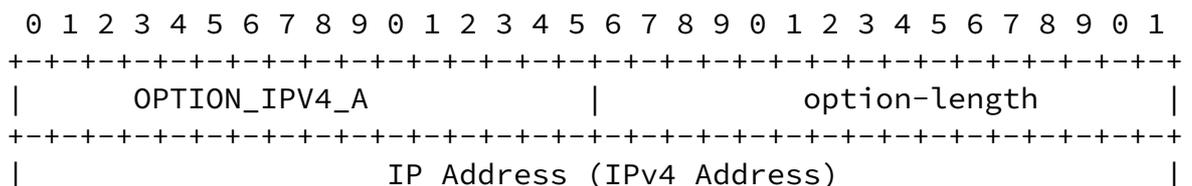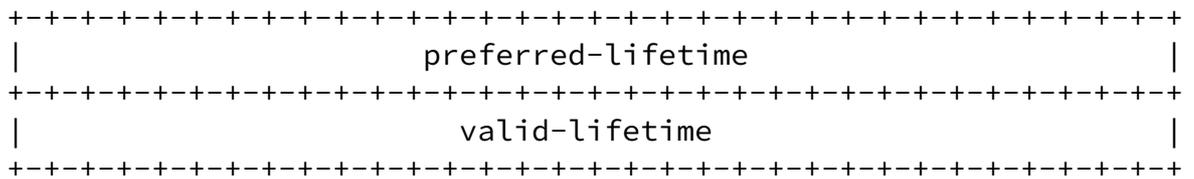
                Figure 1: IPv4 Address DHCPv6 Option

   - option-code: OPTION_IPV4_A (To be assigned by IANA)

   - option-length: 12.

   - preferred-lifetime: The preferred lifetime for the IPv4 address
   in the option, expressed in units of seconds.

   - valid-lifetime: The valid lifetime for the IPv4 address in the
   option, expressed in units of seconds.

3. Port Extended IPv4 Address DHCPv6 Option

3.1. Option Format

   The Port Extended IPv4 address DHCPv6 Option is used to specify a
   shared IPv4 address together with one range of ports (contiguous or
   not).

   The format of the Port Extended IPv4 address Option is provided in
   Figure 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 4 5 6 7 8 9 0 1
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | OPTION_PORT_EXTENDED_A         |          option-length        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |         sub-option-code        |          sub-option-len       |
```

```
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |                         sub-option-content                    |
      .                                                               .
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |                              ...                              |
      .                                                               .
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |                              ...                              |
      .                                                               .
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |                        preferred-lifetime                     |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |                          valid-lifetime                       |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
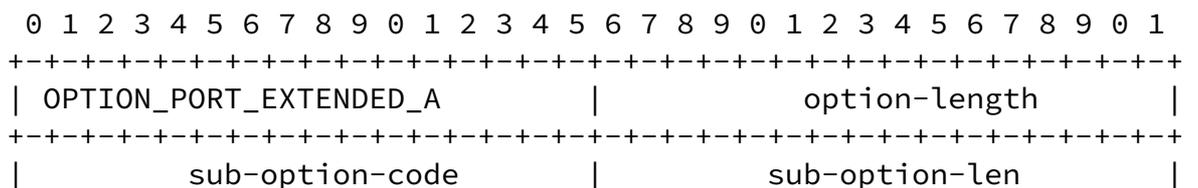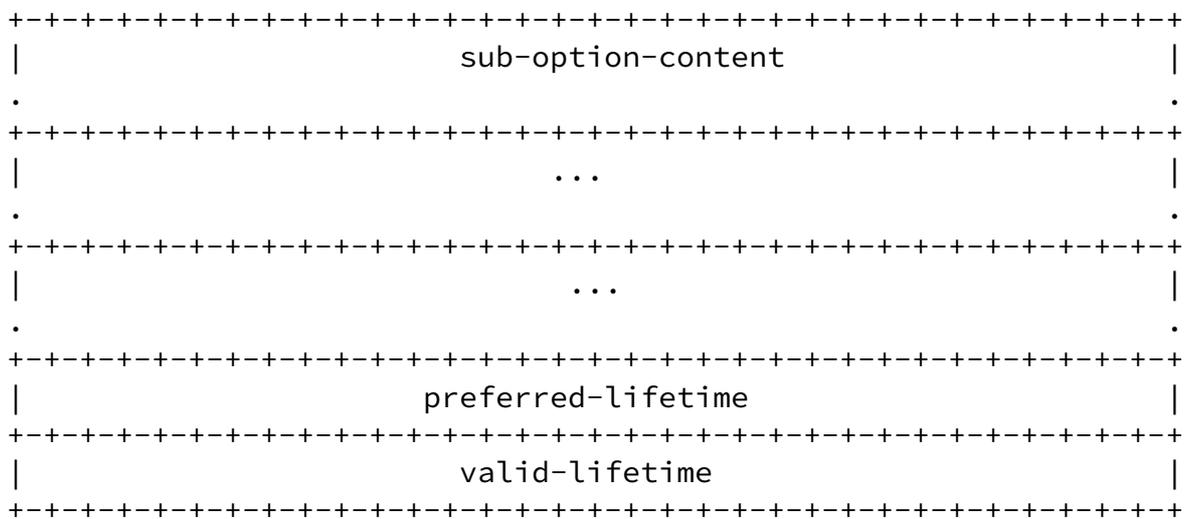
            Figure 2: Port Extended IPv4 Address DHCPv6 Option

     - option-code: OPTION_PORT_EXTENDED_A (To be assigned by IANA)

     - option-length: the length of enclosed sub-option(s) + 4.

     - sub-option code: specifies the code of the included sub-options.
     Two sub-codes are defined in this document: SUB_OPTION_PORT_MASK
     and SUB_OPTION_DELG_RAND.

     - sub-option-len: length of the sub-option.

     - sub-option-content: content of the sub-option

     - preferred-lifetime: The preferred lifetime for the Port Extended
     IPv4 address in the option, expressed in units of seconds.

     - valid-lifetime: The valid lifetime for the Port Extended IPv4
     address in the option, expressed in units of seconds.

3.2. Port Range Sub-Option

Figure 3 provides an overview of the Port Range sub-option.

This sub-option is used to notify a remote peer about an IPv4 address
to be used in conjunction with an allocated Port Range. The Port
Range is allocated on the form of a Port Mask to be applied when
selecting a port value as a source port. The Port Range Sub Option
is used to infer a set of allowed port values. A Port Mask defines a
set of ports that all have in common a subset of pre-positioned bits.
This set of ports is also called Port Range.

A Port Mask is composed of a Port Range Value and a Port Range Mask.

o The Port Range Value indicates the value of the significant bits
   of the Port Mask. The Port Range Value is encoded as follows:

   * The significant bits may take a value of 0 or 1.

   * All the other bits (non significant ones) are set to 0.

o The Port Range Mask indicates, by the bit(s) set to 1, the
   position of the significant bits of the Port Range Value.

This DHCPv6 Sub Option provides a way to negotiate the port range to
be allocated to the peer.

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |      SUB_OPTION_PORT_MASK      |         sub-option-len        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |        Port Extended IP Address (IPv4 Address)                |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |        Port Range Value        |        Port Range Mask       |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
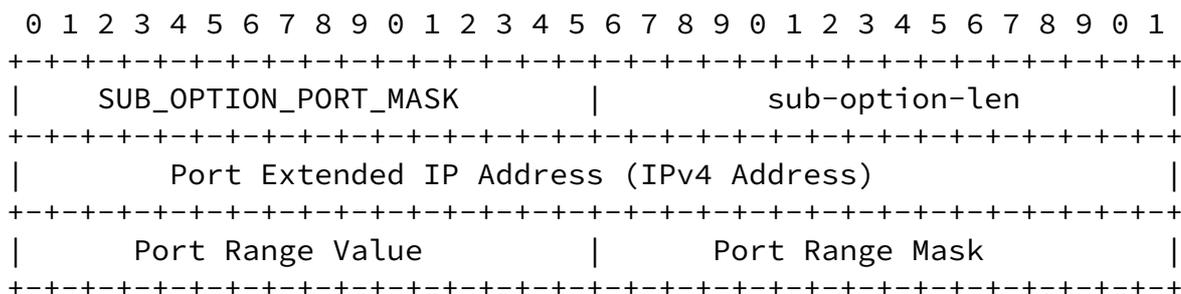
Figure 3: Port Range Sub Option

   - sub-option-code: SUB_OPTION_PORT_MASK (To be assigned by IANA)

- sub-option-len: 8.

        - Port Extended IP Address: specifies the shared IPv4 address

        - Port Range Value (PRV) (16 bits): PRV indicates the value of the
        significant bits of the Port Mask.

        - Port Range Mask (PRM) (16 bits): The Port Range Mask indicates,
        by the bit(s) set to 1, the position of the significant bits of
        the Port Range Value.

    An example of Port Range Mask is provided in Appendix A.

3.3. Delegated Random Port Range Sub-Option

    Figure 4 provides an overview of the delegated random Port Range:

          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
         +-+
         | SUB_OPTION_DELG_RAND | sub-option-len |
         +-+
         | Port Extended IP Address (IPv4 Address) |
         +-+
         | function |
         +-+
         | starting point | number of delegated ports |
         +-+
         | key K (128 bits) |
         | |
         | |
         | |
         +-+

                  Figure 4: Delegated Random Port Option

        - sub-option-code: SUB_OPTION_DELG_RAND (To be assigned by IANA)
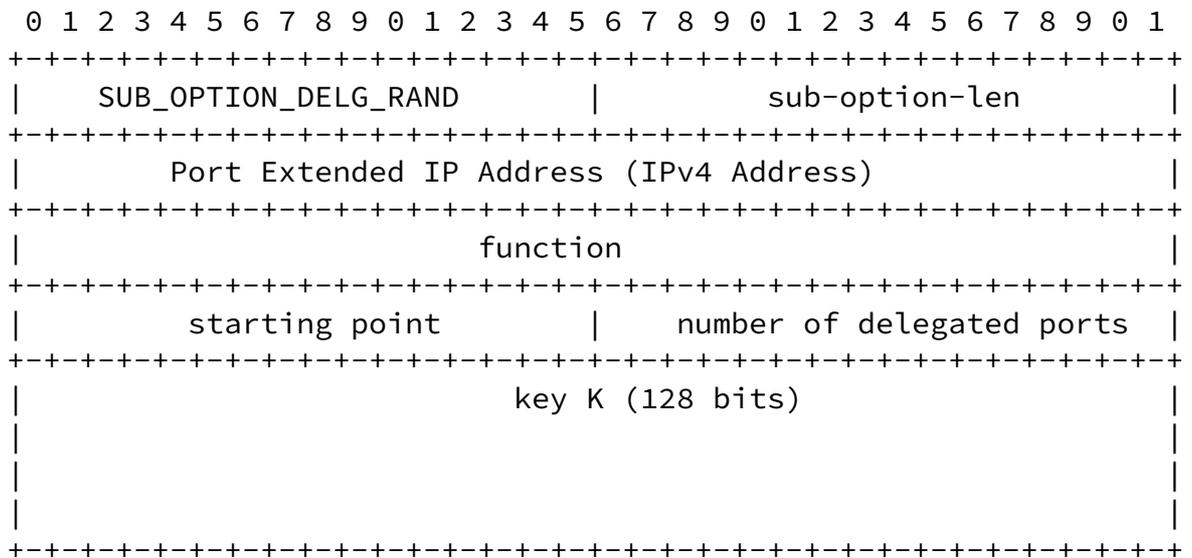
        - sub-option-len: 28.

        - Port Extended IP Address: specifies the shared IPv4 address

        - Function: A 32 bit field whose value is associated with
        predefined encryption functions. For more information about this
        function, refer to [I-D.bajko-pripaddrassign].

        - starting point: A 16 bit value used as an input to the specified
        function.

        - Number of delegated ports: A 16bit value specifying the number
        of ports delegated to the client for use as source port values.

        - Key K: A 128 bit key used as input to the predefined function
        for delegated port calculation.

4. IPv4-Embedded IPv6 Address Format Option

   [I-D.boucadair-behave-ipv6-portrange] defines a Port Range solution
   which assumes IPv6-only network for the delivery of both IPv4 and
   IPv6 connectivity services. The solution is based on IPv4-in-IPv6
   encapsulation for the transport of IPv4 datagrams inside an IPv6-only
   network. For these reasons, an IPv6 prefix is required to build
   destination IPv4-embedded IPv6 addresses of IPv4-in-IPv6 encapsulated
   datagrams issued by a port-restricted device.
   [I-D.ietf-behave-address-format] specifies the format of IPv4
   Embedded IPv6 address.

   Figure 5 provides an example of a structure of an IPv4-embedded IPv6
   address where "Pref6" is a well-known IPv6 prefix:

```
+---------------------------------------------------------------...+
|       Pref6           |Dest. IPv4  |Dest. |         0:0:0:0      |
|                       |address     |port  |                     |
+---------------------------------------------------------------...+
```
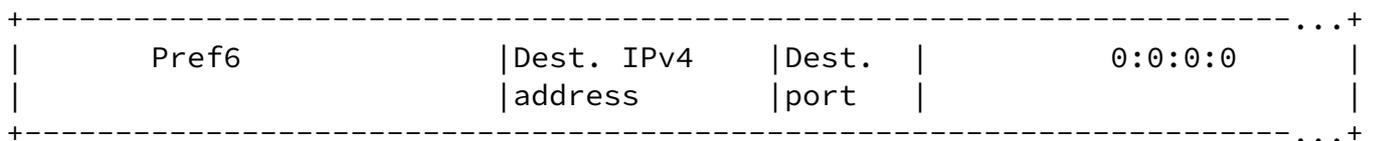
                Figure 5: Example of IPv4-Embedded IPv6 Address

   The IPv4-embedded IPv6 address format used by a device depends on
   several parameters such as the ability of the device to use a port
   number or not when building an IPv4-embedded IPv6 address. Hence
   there is a need to identify several formats. This need is covered by
   the IPv4-embedded IPv6 address Format Option.

   The IPv4-embedded IPv6 address Format Option is structured as shown
   in Figure 6.

```
        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_INFER_V4V6          |          option-length           |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |       format-type          |         IPv6 Prefix length       |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |                                                               |
       |                                                               |
       |             IPv6 Prefix  (Variable)                           |
       |                                                               |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |                    preferred-lifetime                         |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |                     valid-lifetime                            |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
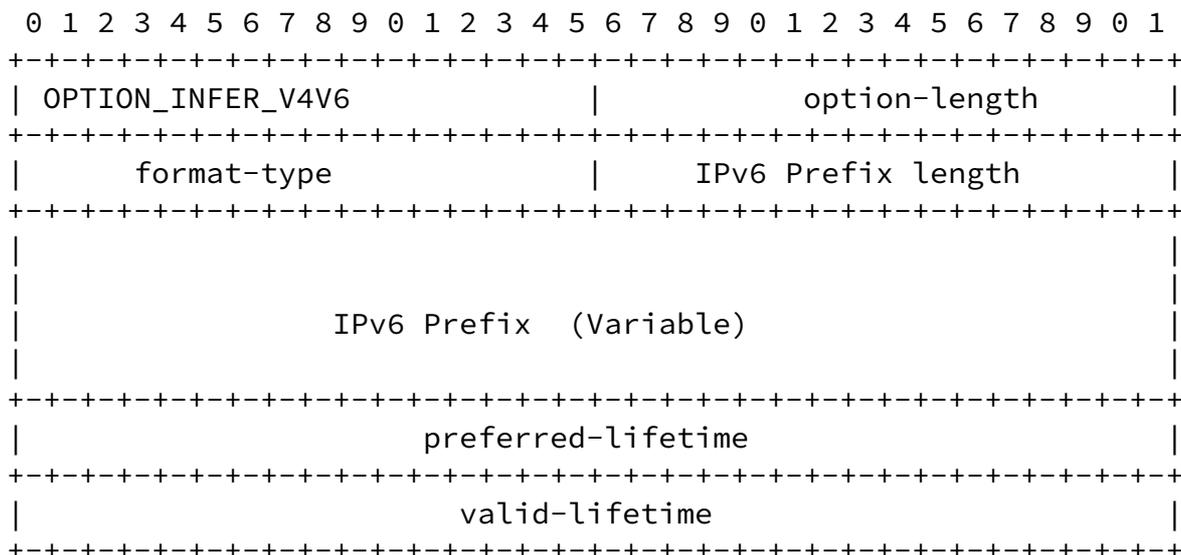
Figure 6: IPv4-inferred IPv6 addresses Format Option

   - option-code: OPTION_INFER_V4V6 (To be assigned by IANA)

   - option-length: Variable.

   - format-type: Indicates the format type of the IPv4-embedded IPv6
   address. The values so far defined are the following ones:

      - "1": When the format-type value is set to 1, the destination
      addresses of IPv4-in-IPv6 datagrams issued by the device have
      the following structure:

```
+---------------------------------------------------------------------+
|      IPv6 Prefix        (128 bits)                                   |
|                                                                     |
+---------------------------------------------------------------------+
```

Figure 7: Format Type (1)

As a matter of fact, the IPv6 Prefix (128 bits long) is an IPv6
address here. The IPv4-in-IPv6 encapsulation scheme is the
simple IPv4-in-IPv6 encapsulation.

- "2": When the format-type value is equal to 2, the
destination IPv6 addresses of IPv4-in-IPv6 datagrams issued by
the device follow the following structure. This format type is

defined in [I-D.boucadair-behave-ipv6-portrange].

```
+----------------------------------------------------------------------
|IPv6 Prefix (32 bits)| Dest. IPv4     |            0::0
|                     | address (32 bits)|
+----------------------------------------------------------------------
```
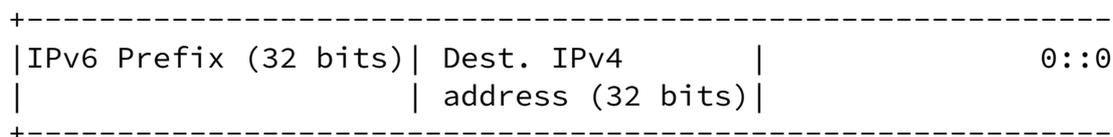
                      Figure 8: Format Type (2)

The IPv4-in-IPv6 encapsulation scheme is the simple IPv4-in-
IPv6 encapsulation.

- "3": When the format-type value is set to 3,

a. if the IPv4 packet to be sent encapsulated bears a protocol
    with port information (case of TCP and UDP, for example),
    the destination IPv6 address of the IPv4-in-IPv6 datagram
    transmitted by the device follows the following structure :

```
+----------------------------------------------------------------------
|IPv6 Prefix (32 bits)| Dest. IPv4     |Dest. Port|     0::0
|                     | address (32 bits)|(16 bits) |
+----------------------------------------------------------------------
```

                      Figure 9: Format Type (3)

b. if the IPv4 datagram to be encapsulated bears a protocol
    without port number (e.g. ICMP), the destination IPv6
    address of the IPv4-in-IPv6 datagram issued by the device
    SHOULD be sent to another IPv6 destination address than the
    destination address depicted in Figure 9. For example,
    such packet without port number MAY be transmitted to a DS-

lite CGN node. Another alternative is to send such packet
                following the Format Type (2) even if Format Type (3) has
                been mandated by the DHCPv6 server to the client, but this
                behavior is NOT RECOMMENDED.
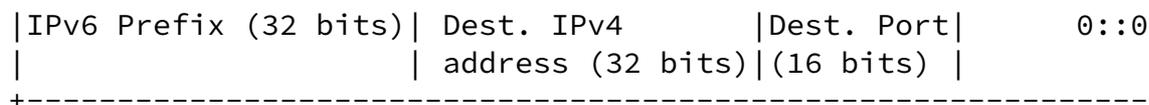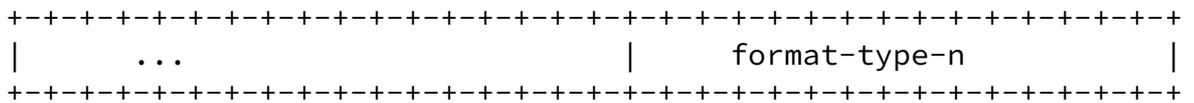
            The IPv4-in-IPv6 encapsulation scheme is the simple IPv4-in-
            IPv6 encapsulation.

            - Other format-type values can be defined later. The format-
            type values from the value 32768 are not reserved. They can be
            used in a ISP scope to encode a proprietary format-type.

        - IPv6 Prefix: Encloses the IPv6 prefix to be used to build IPv4-
        embedded IPv6 addresses. When format-type 1 is used, this prefix
        is an IPv6 address.

        - preferred-lifetime: The preferred lifetime for the IPv6 Prefix
        in the option, expressed in units of seconds.

        - valid-lifetime: The valid lifetime for the IPv6 Prefix in the
        option, expressed in units of seconds.

5. Supported IPv4-Embedded IPv6 Address Formats Option

    A client MAY indicate the format-type values it can support (related
    to IPv4- embedded IPv6 address Formats Option) by including the
    Supported IPv4-embedded IPv6 address Formats Option in a DHCPv6
    Solicit, Request, Renew, Rebind, Confirm or Information-request
    message.

    The order in the list MAY indicate preference in format-types, the
    first value being the preferred one.

    The Supported IPv4-embedded IPv6 address Format Option is structured
    as shown in Figure 10.
         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_SUPPORT_INFER_V4V6 | option-length |
        +-+
        | format-type-1 | ... |

```
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |        ...                     |       format-type-n          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Figure 10: Supported IPv4-inferred IPv6 Address Formats Option

   - option-code: OPTION_SUPPORT_INFER_V4V6 (To be assigned by IANA)

   - option-length: permits to numerate the supported format-type
   values.

   option-length = 2 * number of format-type values. In case of an
   odd number of format-type values, a padding of two "x00" octets is
   to be placed in the ending 16 bits.

   - format-type-i: the values of the format-type supported by the
   client.

6. Behaviour

   A client MAY request IPv4 Address and/or Port Extended IPv4 Address
   and/or IPv4-embedded IPv6 address Format Option(s) by including the

   corresponding Option codes into an Option Request Option (as per
   [RFC3315]). This latter being itself included into a Solicit,
   Request, Renew, Rebind, Confirm or Information-request message.
   Doing so, the client can inform the server about options the client
   wishes to receive.

   The client MAY include IPv4 Address and/or Port Extended IPv4 Address
   and/or IPv4-embedded IPv6 address Format in Solicit, Request, Renew,
   Rebind, Confirm or Information request message as hints to the server
   about parameter values the client would like to be returned. In such
   case, the Option Request Option MUST be sent in the message and
   includes the corresponding Option codes. If the client sends the
   IPv4-embedded IPv6 address Formats as a hint to the server, the value
   of the format-type in the Option is the value of the format-type
   preferred by the client.

   A client MAY indicate the format-type values it can support (related
   to IPv4-embedded IPv6 address Format Option) by including the

Supported IPv4-embedded IPv6 address Formats Option in a Solicit,
Request, Renew, Rebind, Confirm or Information-request message. If
in the same message the client has also included the IPv4-embedded
IPv6 address Format Option as a hint to the server, then the format-
type values listed in the Supported IPv4-embedded IPv6 address
Formats Option has to be taken by the server as complementary
information. In that case, for consistency reasons, the first
format-type value indicated in the Supported IPv4-embedded IPv6
address Formats Option MUST be the same value (i.e. the preferred
one) as the one in the IPv4-embedded IPv6 address Format Option.

If a client receives the IPv4 Address Option in conjunction with an
IPv4-embedded IPv6 address Format Option, all IPv4 datagrams MUST be
encapsulated in IPv6 according to the features indicated in this
latter Option, meaning that the destination IPv6 addresses MUST be
IPv4-embedded addresses as specified in the Option.

If a client receives the Port Extended IPv4 Address Option, the
client MUST constrain the source port number of included Port
Extended IPv4 Address to be within the provisioned Port Range. If a
client receives the IPv4 Address Port Extended IPv4 Address Option in
conjunction with the IPv4-embedded IPv6 address Format Option, all
IPv4 datagrams MUST be encapsulated in IPv6 according to the features
indicated in this latter Option, meaning that the destination IPv6
addresses MUST be IPv4-embedded address as specified in the Option.

If a client receives a Port Extended IPv4 Address Option but no Port
Range Sub-Option included, it MUST use the conveyed IPv4 address as
non restricted one. If in addition, it has received an IPv4-embedded
IPv6 address Format Option, all IPv4 datagrams MUST be encapsulated

Boucadair, et al.   Expires June 24, 2010   [Page 13]

in IPv6 according to the features indicated in this latter Option,
meaning that the destination IPv6 addresses MUST be IPv4-embedded
addresses as specified in the Option.

If a client receives a Port Extended IPv4 Address Option with the
Port Range Sub-Option enclosed but with the IPv4 address set to
"0.0.0.0", the client MUST constrain all IPv4 communications to be
within the allocated Port Range. In such case, the IPv4 address the
client will use is allocated by other means than by DHCPv6 Port
Extended IPv4 Address Option (e.g. through DHCP (IPv4), IPv4 address
derived from an IPv6 address, ...). It is NOT RECOMMENDED that the

client or the server use the IPv4 Address Option in conjunction with
a Port Extended IPv4 Address option with Port Range Sub-Option
present and IPv4 address set to "0.0.0.0", because the use of the
Port Extended IPv4 Address Option with a correct IPv4 address is more
efficient.

When a peer issues a request enclosing one or more options (defined
in this document), if the server does not support this (ese)
option(s), the DHCPv6 server ignores the corresponding option.

7. IANA Considerations

This document requests IANA to assign numbers for these DHCPv6
options:

    - OPTION_IPV4_A

    - OPTION_PORT_EXTENDED_A

    - OPTION_INFER_V4V6

    - OPTION_SUPPORT_INFER_V4V6

And the following sub-options:

    - SUB_OPTION_PORT_MASK

    - SUB_OPTION_DELG_RAND

8. Security Considerations

All security considerations described in [RFC3315] apply for this
specification.

9. Acknowledgements

The authors would like to thank Christian JACQUENET for his review.

10. References

10.1. Normative References

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Appendix A. Port Mask Example

   The following figure (Figure 11) provides an example of the resulting
   Port Range when:

   - Port Range Mask is set to 0001010000000000 (5120) and

   - Port Range Value is set to 0000010000000000 (1024).

   Ports belonging to this port range must have the 4th bit (resp. the
   sixth one), from the left, set to 0 (resp. 1). Only these ports will
   be used by the peer when enforcing the configuration conveyed by
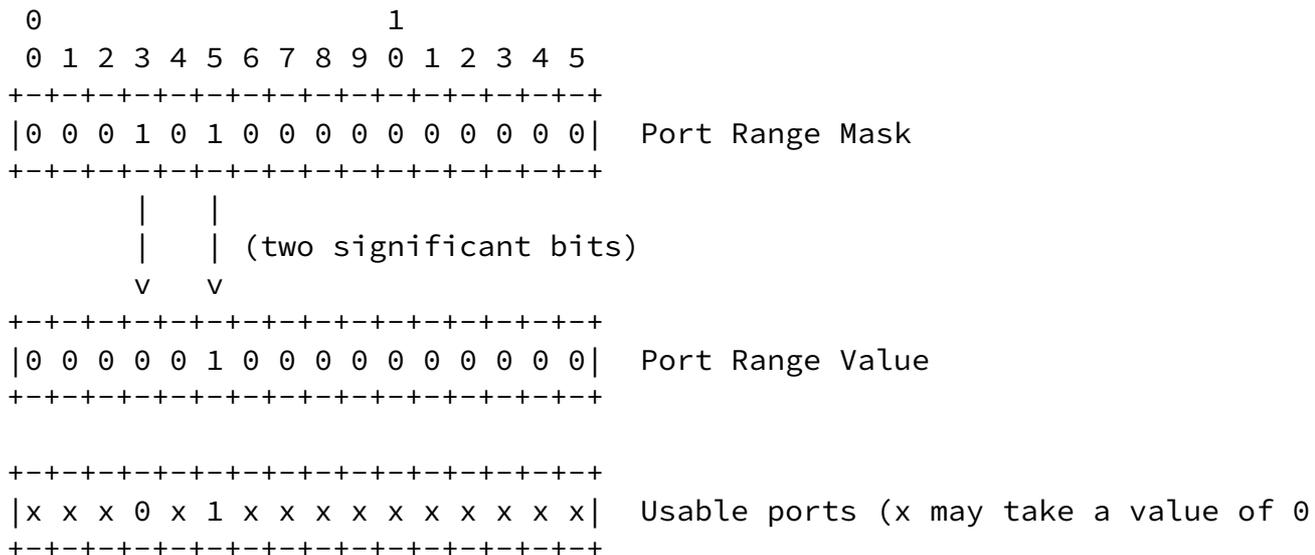   DHCPv6.

       0   1
       0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0| Port Range Mask
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
               | |
               | | (two significant bits)
               v   v
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0| Port Range Value
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |x x x 0 x 1 x x x x x x x x x x| Usable ports (x may take a value of 0
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

         Figure 11: Example of Port Range Mask and Port Range Value

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