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GRE-based L2 Tunneling with PMIPv4
draft-tsirtsis-l2gre-pmipv4-00.txt

Status of this Memo

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Abstract

   This specification introduces mechanisms for creating a GRE-based L2
   Tunnel with PMIPv4.

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1. Requirements notation

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].

2. **Introduction**

   The Mobile IPv4 (MIPv4) specification [RFC3344] defines optional
   support for GRE tunneling [RFC2784]. Additionally, there is work in
   progress on defining extensions that enable signaling of GRE keys
   [RFC2890] to be used when MIPv4 uses GRE tunneling
   [draft-yegani-gre-key-extension-02.txt], and also work in progress on
   defining mobility management based on Proxy Mobile IPv4 (PMIPv4)
   [draft-leung-mip4-proxy-mode-02.txt].

   The primary use case for [draft-yegani-gre-key-extension-02.txt] is
   the use of GRE keys to support overlapping IPv4 address spaces on the
   same HA. The mechanisms defined by
   [draft-yegani-gre-key-extension-02.txt] anticipate the use of
   unidirectional GRE keys under the control of the sender i.e., the FA
   (or equivalently the MPA in the case of PMIPv4) indicates (in a
   Registration Request message) the GRE key to be used for reverse
   tunneling, and the HA indicates (in the corresponding Registration
   Reply message) the GRE key to be used for forward tunneling.

   In this document, the mechanisms defined in
   [draft-yegani-gre-key-extension-02.txt] are extended to support the
   use of bidirectional GRE keys under the control of the HA that can be
   MN specific, realm specific, or otherwise.

   Also, the mechanisms defined in this specification allow a GRE-based
   L2 tunnel to be created without necessarily allocating an address to
   the MN. This allows MNs to use any address configuration mechanism
   they want directly with the HA including, DHCPv4, DHCPv6, Stateless
   Address Autoconfiguration etc.

[3](#). **Overview**

In this specification, we define that when the Key Identifier field
in a GRE Key extension [draft-yegani-gre-key-extension-02.txt]
included in a Registration Request message is set to a predefined
known value (i.e., "0"), the MPA requests that the HA assign a
bidirectional GRE key for the given registration. The HA allocates a
bidirectional GRE key and returns it in the Key Identifier field of a
GRE Key extension in the Registration Reply message. Thus, the value
of the Key Identifier field returned by the HA is used as the GRE key
for both forward and reverse tunneled packets.

The mechanisms defined herein, also allow a GRE-based L2 tunnel to be
established via PMIPv4. The MN can then run any address allocation
procedure, including DHCPv4 and stateless address autoconfiguration
for IPv6 etc, directly with the HA on which the L2 tunnel terminates.
To enable this capability, a new flag is defined in the GRE Key
extension [draft-yegani-gre-key-extension-02.txt], requesting the
establishment of an GRE-based L2 tunnel. In that case, the binding
created in the HA is between a GRE key and a CoA. This requires the
use of unidirectional or bidirectional GRE keys that are unique per
MN.

4. Flag definition for GRE key Extension

   The following extension is based on the GRE Key extension defined in
   [draft-yegani-gre-key-extension-02.txt]. This specification defines
   the "A" flag shown below, from within the field previously defined as
   Reserved.

```
     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     |A|         Reserved            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                        Key Identifier                        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Type

      See [draft-yegani-gre-key-extension-02.txt]

   Length

      See [draft-yegani-gre-key-extension-02.txt]

   A

      Requests GRE-based L2 Tunneling Mode

   Reserved

      See [draft-yegani-gre-key-extension-02.txt]

   Key Identifier

      See [draft-yegani-gre-key-extension-02.txt]

5. Initial Registration

5.1. Sending the Registration Request

   According to [draft-yegani-gre-key-extension-02.txt], an FA (or
   presumably MPA) can send a Registration Request message with a GRE
   Key extension to request use of GRE keys as part of GRE tunneling.
   This specification allows the sender of a Registration Request
   message with a GRE Key extension to further request the use a GRE-
   based L2 tunnel by setting the "A" flag as follows:

   "0" Indicates normal GRE Tunneling Mode.

   "1" Indicates GRE-based L2 Tunneling Mode. In this case the Key
   Identifier(s) corresponding to the registration MUST be unique per
   MN.

   In accordance with this specification, the MPA can also request the
   use of a bidirectional key according to value of the Key Identifier
   field of the GRE Key extension in the Registration Request message:

   When the Key Identifier field is set to "0" the sender requests a
   bidirectional GRE key to be defined by the HA.

   When the Key Identifier field is set to any other value, it
   indicates the value of the GRE key to be used for tunneling from
   the MPA to the HA.

5.2. Receiving the Registration Request

   The following defines GRE Key extension processing to be performed by
   the HA in addition to that described in
   [draft-yegani-gre-key-extension-02.txt].

   If in a Registration Request message with a GRE Key extension, the
   Key Identifier field is set to "0" and the A flag is set to "0", then
   the HA MUST allocate a bidirectional GRE key, which need not be
   unique per MN. The allocated bidirectional GRE key MAY be realm
   specific or otherwise based on HA policy.

   If in a Registration Request message with a GRE Key extension, the
   Key Identifier is set to a value other than "0" and A flag is set to
   "0", then the HA SHOULD accept the value of the Key Identifier field
   as the GRE key to be used for reverse tunneling from the MPA to the
   HA and allocate a unidirectional GRE key, which need not be unique
   per MN, to be used for forward tunneling. The allocated
   unidirectional GRE key MAY be realm specific or otherwise based on HA
   policy.

If in a Registration Request message with a GRE Key extension, the
Key Identifier is set to "0" and the A flag is set to "1", then the
HA MUST allocate a bidirectional GRE key, which MUST be unique per
MN. In this case the HA, creates an L2 tunnel for the MN and
maintains a binding between the bidirectional GRE key and the CoA of
the MN.

If in a Registration Request message with a GRE Key extension, the
Key Identifier is set to a value other than "0" and the A flag is set
to "1", then the HA SHOULD accept the value of the Key Identifier
field as the GRE key to be used for reverse tunneling from the MPA to
the HA and allocate a unidirectional GRE key, which MUST be unique
per MN, to be used for forward tunneling. In this case the HA,
creates an L2 tunnel for the MN and maintains a binding between the
GRE keys for each direction and the CoA of the MN.

5.3. Sending the Registration Reply

Provided a Registration Request message with a GRE Key extension is
accepted, the HA MUST include a GRE Key extension in the
corresponding Registration Reply message. In all cases, the Key
Identifier field of the GRE Key extension included in the
Registration Reply message is set to the value of the GRE key
allocated by the HA in response to the corresponding Registration
Request message. The A flag of the GRE Key extension included in the
Registration Reply message is set to the same value as the A flag of
the corresponding Registration Request message.

If the GRE key extension is not accepted by the HA, the Registration
Request SHOULD be rejected with an appropriate rejection code e.g.,
Administratively Prohibited, as per [RFC3344].

5.4. Receiving the Registration Reply

Provided a Registration Request message with a GRE Key extension is
accepted, the Registration Reply message will also include a GRE key
extension.

If the GRE key extension in the Registration Request message included
a Key Identifier value of "0" then, the receiver of this message MUST
accept the value of the Key Identifier field in the GRE key extension
in the Registration Reply message as the bidirectional GRE key to be
used for this MN.

If the GRE key extension in the Registration Request message included
a Key Identifier value other than "0" then, the receiver of this
message MUST accept the value of the Key Identifier field in the GRE
key extension in the Registration Reply message as the GRE key to be

used for this MN in the forward direction.

5.5. Registration Tables

5.5.1. Home Agent

In addition to what is defined in [RFC3344], Section 3.8.1., the
following information needs to be retained by the HA:

   - the mobile node's GRE key in the reverse direction

   - the mobile node's GRE key in the forward direction

Also note that unlike what is indicated in the same section of
[RFC3344], in some cases the HoA may not be known.

5.5.2. Mobility Proxy Agent

While not explicitly outlined in
[draft-leung-mip4-proxy-mode-02.txt], an MPA must maintain
information associated with registrations. In addition to what is
required in support of [draft-leung-mip4-proxy-mode-02.txt], the
following information needs to be retained by the MPA:

   - the mobile node's GRE key in the reverse direction

   - the mobile node's GRE key in the forward direction

6. Reregistrations

6.1. Registration Request

The MPA SHOULD include the GRE Key extension in all reregistrations.
If the GRE key, set-up by an earlier MPA, is known, it SHOULD be
included in the Key Identifier field of the extension. If the GRE
key is not known or a different one needs to be negotiated, the
reregistration message has to follow the same rules with the initial
registration message defined in Section 5.1.

6.2. Registration Reply

Assuming the subsequent Registration Request message includes a GRE
key extension that reflects the negotiated GRE key, the HA simply
copies the extension to the Registration Reply.

If the GRE key extension included in the subsequent Registration
Request does not reflect the agreed key, the request will have the
same effect as the initial request and the HA MUST treat it as in
Section 5.2 and the reply MUST be formed as defined in Section 5.3.

7. L2 Tunneling and Address Allocation

When a GRE-based L2 tunnel is requested (the A flag in the GRE key
extension is set to "1", see Section 5.1), the binding communicated
by the Registration Request message is between the GRE key(s) and the
CoA rather than an HoA and the CoA.

Unlike [RFC3344], in this case, if the HoA field of the Registration
Request message is set to "0", the HA is NOT REQUIRED to allocate an
IP Address in the Registration Reply message. Instead the HA MAY
also set the HoA field in the Registration Reply message to "0".

Also, when L2 Tunneling is used as defined in this specification, the
MN MAY use DHCPv4, DHCPv6, IPv6 Address Autoconfiguration or any
other mechanism directly with the HA, to configure its addresses.
After addresses have been allocated, the MN MAY register them with
the HA using appropriate MIPv4 mechanisms.

8. Security Considerations

   This specification operates in the security constraints and
   requirements of the underlying protocols.

9. Normative References

   [RFC2119]   Bradner, S., "Key words for use in RFCs to Indicate
               Requirement Levels", BCP 14, RFC 2119, March 1997.

   [RFC2784]   Farinacci, D., Li, T., Hanks, S., Meyer, D., and P.
               Traina, "Generic Routing Encapsulation (GRE)", RFC 2784,
               March 2000.

   [RFC2890]   Dommety, G., "Key and Sequence Number Extensions to GRE",
               RFC 2890, September 2000.

   [RFC3344]   Perkins, C., "IP Mobility Support for IPv4", RFC 3344,
               August 2002.

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