DHCPv6 Extension for Configuring Hosts with Multiple Interfaces
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Abstract

This document defines DHCPv6 Options to configure a multi-homed host’s routing table with new entries when the host attaches to a new network on a new interface.

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1. Introduction

Traditional routing considered only the destination address in IPv4/v6 header. Policy-based routing on the hand considers other fields in the header sometimes even the payload. In IPv6, the hosts receive router advertisements (RA) containing information useful for enforcing policy-based routing. However in some networks, e.g. cellular networks, DHCP servers can be used to help multi-homed mobile nodes configure their routing tables.

Using a single default route would lead to routing of all flows through a single interface. Such a configuration makes it impossible to use multiple interfaces simultaneously if the host is multi-homed.

Requirements of supporting multiple interfaces in hosts without involving mobility protocols are discussed in [I-D.ietf-mif-problem-statement], [I-D.yang-mif-req]. DHCP is identified as a protocol to communicate interface management policies between MIF nodes and the network.

The IPv6 hosts receive router advertisements and then populate their Default Router List and Prefix List based on information in the router advertisements [RFC2461]. [RFC4191] extended RAs with Route Information Option and added Default Router Preference. Such RAs if available would help multi-homed mobile nodes configure better to enable the simultaneous use of all interfaces.

In this document we define a new DHCPv6 [RFC3315] Option. This option is to inform multi-homed hosts about the routes and other useful information available on the new network that the host has just connected. It is appropriate to use DHCP for this purpose because DHCP is already needed for initial configuration of the host’s interface, e.g. for address assignment.

2. Terminology

This document uses the terminology defined in [RFC3315] and [RFC3633].

3. Configuring Routing Tables of Multi-homed Hosts

An IPv6 routing table contains these entries (non exhaustive list): prefix, prefix length, preference value, lifetime, and the address of the next-hop router.

Multi-homed hosts receive configuration information on each
interface. Routers send router advertisements. DHCP servers provide host configuration information. SDOs are defining servers such as Access Network Discovery and Selection Function (ANDSF) [3GPP23402]. ANDSF can also provide node configuration information on SDO interfaces. Configuration information helps host set up and update important databases that the host uses such as the routing table.

Since IPv6 allows multiple unicast addresses to be assigned to interfaces, IPv6 hosts face the problem of default source and destination address selection when initiating communication. [RFC3484] defines algorithms for this purpose.

In this document we define a new DHCPv6 Option called multi-homed routing policy entry option. Using this Option DHCPv6 server can inform DHCPv6 client on the default routes available on the interface which the host is about to connect. The option also allows DHCP server to provide more information on the flows such as more sophisticated flow description. The host receives the route information ordered with priority which allows the host to select the right interface to start communication.

DHCP server gets information about host’s interface using Interface Info Sub-option included in the multi-homed routing policy entry option. A MIF host MAY include one Interface Info Sub-option for each of its interfaces. A MIF host requesting routing information MAY set preferred-lifetime to a value in multi-homed routing policy entry option. DHCP server considers preferred-lifetime value it received and it sets valid-lifetime value in the reply. Valid-lifetime value defines the expiration value of the routing policy entry.

Policy entries are identified using Policy Identifiers (PID). Each option MUST have a unique PID.

4. DHCPv6 Option

4.1. Option Format

A new option is defined to carry the host routing information. It is shown in Figure 1.

DHCP server MAY send a Reply message containing multi-homed routing policy entry option. DHCP client MUST add an entry to its routing table based on this option. DHCP client MAY modify other tables such as Default Router List or Pref List [RFC4191].

DHCP Client MAY include multi-homed routing policy entry option in
Option Request Option [RFC3315] in DHCP Request message. DHCP Server MUST include multi-homed routing policy entry option in the corresponding Reply message. The option contains a list of routing policies, each of them containing the flow description followed by the route to apply when datagram to forward is matching.

```
+-----------------------------+-----------------------------+
|          OPTION_MHRPE       |       option-length         |
+-----------------------------+-----------------------------+
|    sub-option-code          |     sub-option-len          |
+-----------------------------+-----------------------------+
|                        sub-option-content                   |
|                                ...                             |
|                                ...                             |
|                                ...                             |
+-----------------------------+-----------------------------+
|                             PID            |  Reserved                 |
+-----------------------------+-----------------------------+
|                              preferred-lifetime                  |
+-----------------------------+-----------------------------+
|                               valid-lifetime                     |
+-----------------------------+-----------------------------+
```

Figure 1: DHCPv6 Multi-Homed Routing Policy Option

- Option-code: OPTION_MHRPE multi-homed routing policy entry option (To be assigned by IANA).
- Option-length: Total length of the suboptions + 4.
- sub-option-code: the code of the included sub option. In this document SUB_OPTION_FLOW_DESC, SUB_OPTION_QOS_INFO, SUB_OPTION_PREFIX and SUB_OPTION_ROUTER_ADDRESS are defined.
- sub-option-len: length of the sub-option.
- sub-option-content: content of the sub-option.
- PID: the Policy Identifier field is an 8-bit unsigned integer that includes the identifier for the policy.
- Reserved: 24 bits set to zero by the sender ignored by the receiver.
- preferred-lifetime: the preferred lifetime in units of seconds for the multi-homed routing policy entry option.
4.2. Flow Description Sub-option

Flow Description Sub-option is used to describe the flow associated to the routing policy. More than one flow description MAY be included. Flow descriptions are usually in binary format but textual formats are also allowed. The preferred interface for this flow is included in Interface Info Sub-option.

```
+----------------------------------+-
|   SUB_OPTION_FLOW_DESC           |
+----------------------------------+-
|   sub-option-len                 |
+----------------------------------+-
|   FD-Type  | FD-len                  |
+----------------------------------+-
|                 Flow Description ...
+----------------------------------+-
```

Figure 2: Flow Description Sub-option

- option-code: SUB_OPTION_FLOW_DESC (to be assigned by IANA)
- option-length: Variable.
- FD-Type: type of the flow description:
  - (0) Reserved
  - (1) Binary
  - (2) Text
- FD-len: length of the flow description that follows in bytes.
- Flow Description: this field contains flow description in binary such as in [I-D.ietf-mext-binary-ts] or in textual format. This field is of length FD-length.

4.3. QoS Info Sub-option

This Sub-option contains quality of service required for the flow on the interface, as specified in Interface Info Sub-option, e.g. 150kbps for video streaming on 3G and 400kbps on Wifi.
4.4. Flow Route Prefix Sub-option

This Sub-option defines IPv6 prefix over which the flow, as defined in flow description sub-option, will be routed. One flow route prefix sub-option MAY be included for each flow description sub-option.
4.5. IPv6 Router Address Sub-option

This sub-option defines the default router address for this route. Flow Route Prefix Sub-option and IPv6 Router Address Sub-option define a route.

For each flow there MUST be at least one route. If more than one route is defined the first route is the primary route.

Figure 4: Flow Route Prefix Sub-option

- option-code: SUB_OPTION_FR_PREFIX (to be assigned by IANA).
- option-length: Variable.
- prefix-len: prefix length of the destination prefix over which the flow will be routed.
- IPv6 prefix: destination prefix over which the flow will be routed. The first prefix-len bits make up the prefix. The rest is ignored.

Figure 5: IPv6 Router Address Sub-option

- option-code: SUB_OPTION_ROUTER_ADDRESS (to be assigned by IANA).
- option-length: Variable.
- prefix-length: prefix length of the destination prefix over which the flow will be routed.
- IPv6 Router Address: destination prefix over which the flow will be routed. The first prefix-length bits make up the prefix. The rest is ignored.
4.6. Interface Info Sub-option

Interface Info Sub-option is used to provide information about each interface of the host. One Interface Info sub-option SHOULD be included per interface of a MIF host.

Link layer address is a MAC address for IEEE interfaces such as Ethernet or Wi-Fi. Link layer address could be International Mobile Subscriber Identity (IMSI) for some 3GPP interfaces.

```
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_INTERFACE_INFO | sub-option-len |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| ATT | Length | |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Link Layer Address | |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 6: Interface Info Sub-option

- option-code: SUB_OPTION_INTERFACE_INFO (to be assigned by IANA)
- option-length: 16.
- ATT: this is an 8-bit field that specifies the access technology of the interface. The values for this field are assigned from Access Technology Type Option type values of IANA related to [RFC5213].
- Length: the length in bytes of Link Layer address.
- The variable length link-layer address. MAC address (if exists) is placed as value in this field.

5. Security Considerations

This document does not by itself introduce any security issues.
6. IANA Considerations

IANA is requested to assign an option code to the following options from the option-code space defined in "DHCPv6 Options" section of the DHCPv6 specification [RFC3315].

<table>
<thead>
<tr>
<th>Option Name</th>
<th>Value</th>
<th>Described in</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPTION_MHPTE</td>
<td>TBD</td>
<td>Section 4.1</td>
</tr>
<tr>
<td>SUB_OPTION_FLOW_DESC</td>
<td>TBD</td>
<td>Section 4.2</td>
</tr>
<tr>
<td>SUB_OPTION_QOS_INFO</td>
<td>TBD</td>
<td>Section 4.3</td>
</tr>
<tr>
<td>SUB_OPTION_FR_PREFIX</td>
<td>TBD</td>
<td>Section 4.4</td>
</tr>
<tr>
<td>SUB_OPTION_ROUTER_ADDRESS</td>
<td>TBD</td>
<td>Section 4.5</td>
</tr>
<tr>
<td>SUB_OPTION_INTERFACE_INFO</td>
<td>TBD</td>
<td>Section 4.6</td>
</tr>
</tbody>
</table>

Table 1: DHCPv6 Options

7. Acknowledgements

The authors acknowledge Mohamed Boucadair who provided useful comments for this document.

8. References

8.1. Normative References


8.2. Informative references


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