               Source Address Dependent Route Information Option for Router
                              Advertisements
                     draft-pfister-6man-sadr-ra-00

Abstract

   This document defines the Source Address Dependent Route Information
   option for Router Advertisements, enabling source address dependent
   routes to be installed in hosts by neighboring routers. It also adds
   a new flag to the existing Route Information option for backward
   compatibility purposes.

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1. Introduction

Hosts may have multiple non-link-local addresses, possibly provided
by different routers located on one or multiple links. In such
situations, hosts must make sure packets with a given source address
are sent to the right next-hop router. Failing in selecting the
right next-hop router may, at best, induce sub-optimal routing and,
at worst, cause the packet to be dropped ([RFC2827]). Rules 5 and
5.5 from the default address selection algorithm [RFC6724] make sure
that, once the next-hop is chosen, care is taken to pick the right
source address. Nevertheless, these rules may fail in some
situations, e.g., when the same prefix is advertised on the same link
by different routers. Additionally, they don't handle situations
where the application picks the source-address before sending the
packet.

This document defines the Source Address Dependent Route Information
Option for Router Advertisements [RFC4861], enabling source address
dependent routes to be installed in hosts by neighboring routers. It
also adds a new flag to the Route Information Option meaning that the
option may be ignored by hosts implementing this specification.

2. Source Address Dependent Route Information Option

This section defines a new Router Advertisement option called the
Source Address Dependent Route Information option. Its use is
similar to the Route Information option defined in [RFC4191] but also

includes additional source prefix fields, allowing source address
dependent routes to be installed on hosts receiving the Router
Advertisement.

```
 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    |   Src Length  |   Dst Length  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Route Lifetime                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Resvd|Prf|Resvd|       Source Prefix (Variable Length)         |
+-+-+-+-+-+-+-+-+                                               +
.                                                               .
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Destination Prefix (Variable Length)             |
.                                                               .
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

             Source Address Dependent Route Information Option

Type: To be defined by IANA.

Length: The length of the option (including the Type and Length
   fields) in units of 8 octets. It ranges from 2 to 6.

Src Length: The number of significant bits in the Source Prefix
   field.

Dst Length: The number of significant bits in the Destination Prefix
   field.

Route Lifetime: Time in seconds (relative to the time the packet is
   sent) that the prefix is valid for route determination. A value
   of all one bits (0xffffffff) represents infinity.

Resvd (Reserved): Bits reserved for futur use. They MUST be set to
   zero by the sender and ignored by the receiver.

Prf (Route Preference): The route preference as specified in
   [RFC4191]. When the Reserved value (10) is received, the option
   MUST be ignored.

Source Prefix: The source prefix significant bits padded to the next
   8-bits boundary.

Destination Prefix: The destination prefix significant bits padded
   to the next 64-bits boundary.

Note: The alignment is a bit awkward. I am not sure reserving 24
bits for the purpose of aligning the source prefix would be helpful.
The destination prefix cannot be aligned neither due to the variable
length of the source prefix, unless we add unused bytes in between.
Propositions are welcome concerning the best format for this option.

3. Route Information Option ignore flag

This document adds the Ignore flag to the Route Information option
specified in [RFC4191]. It is used in order to configure type C
hosts with more specific routes which will be ignored by hosts
implementing this specification. Most of the time, such options with
the I bit set will be used in conjunction with Source Address
Dependent Route Information options including the same or a similar
destination prefix.

The option is re-defined with an additional flag.

```
 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     | Prefix Length |I|Rsv|Prf|Resvd|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Route Lifetime                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Prefix (Variable Length)                   |
.                                                               .
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

                      Route Information Option
```

I flag: Ignore flag. When this flag is set, the option MUST be
   ignored.

Other fields: No changes (see [RFC4191]).

4. Host Behavior

Hosts implementing this specification MUST behave similarly to type C
hosts as specified in [RFC4191], unless stated otherwise in this
section.

Hosts implementing this specification MUST use a Routing Table with
source address dependent entries. Such entries have a source prefix,

a destination prefix, a preference value, a lifetime, an interface
and a next-hop router address.

When sending a packet, hosts MUST select the next-hop router based on
the usual source address dependent routing algorithm, i.e., by
picking the matching entry with, by order of precedence:

   The longest destination address match.

   The longest source address match.

   The highest route preference value.

In case of a tie, hosts MAY either pick one entry or use load-sharing
techniques.

4.1. Receiving Source Address Dependent Route Information option

When receiving a Source Address Dependent Route Information option, a
host MUST look for an existing routing entry with:

1. The same source prefix.

2. The same destination prefix.

3. The next-hop router address equal to the source address of the
    received Router Advertisement.

4. The outgoing interface equal to the interface the Router
    Advertisement is received on.

If no routing entry is found and the Route Lifetime is not null,
insert a routing entry with the given source prefix, destination
prefix, route preference, having as next-hop the source address of
the received Router Advertisement, on the interface receiving the
packet. If the Route Lifetime is not infinity, set the routing entry
timer to the Route Lifetime value.

If a routing entry is found and the Route Lifetime is not null,
cancel the associated timer. If the Route Lifetime is not infinity,
set it to the Route Lifetime value. Finally, update the entry
preference with the Route Preference value.

If a routing entry is found and the Route Lifetime is null, remove
the routing entry.

If both destination and source prefixes specified by the option are
::/0, the router preference and route lifetime present in the option

override the default router lifetime and default router preference
present in the header of the Router Advertisement.

4.2. Receiving Route Information option

When receiving a Route Information option, a host MUST behave as
follows:

   If the I bit is set, ignore the option.

   Otherwise, act as when receiving a Source Address Dependent Route
   Information option with source prefix length set to zero.

5. Router Behavior

Routers MAY send one or multiple Source Address Dependent Route
Information options in their Router Advertisements.

Routers MUST NOT send multiple Route Information options with the
same Prefix (no matter what the Ignore flag value is) or multiple
Source Address Dependent Route Information options with the same
Source and Destination Prefixes. Additionally, routers MUST NOT send
a Route Information option with the Ignore bit not set and a Source
Address Dependent Route Information with the source length equal to
zero if the Prefix from the Route Information option is equal to the
Destination Prefix from the Source Address Dependent Route
Information option.

The Ignore bit is used to configure hosts implementing this
specification differently from other types of hosts (A, B or C).
Different combinations will result in different behaviors. For
instance:

   When injecting a source address dependent route is desired, a
   Source Address Dependent Route Information option is sent in every
   RA. Depending on the context, a Route Information with the same
   prefix and the Ignore bit set MAY be sent as well in order to
   inject non source address dependent route into type C hosts.
   Obviously, Source Address Dependent Route Information options can
   be used to inject non-source dependent routes as well. This
   technique and the use of the Ignore bit allow type C hosts and
   hosts implementing this specification to be configured with
   independent routes.

   When injecting a non source address dependent route is desired,
   the router MAY either use a Route Information option with the
   Ignore flag not set, in which case type C hosts as well as hosts
   implementing this specification will be configured, or use a

Source Address Dependent Route Information option with a source
prefix ::/0, in which case type C hosts will not be configured.

When a Source Address Dependent Route Information option is removed
from the set of advertised options, the router SHOULD send multiple
unsolicited Router Advertisements with the Route Lifetime set to
zero.

6. Security Considerations

This document allows routers to configure neighboring hosts with
source address dependent routing entries. Based on [RFC4191],
attackers can inject default routes to type A and B hosts as well as
destination address dependent routes to type C hosts. The Source
Address Dependent Route Information option adds the ability for
attackers to inject even more specific routes, making attacks
slightly harder to detect.

7. IANA Considerations

IANA is kindly asked to reserve a Router Advertisement option type to
be used by the Source Address Dependent Route Information option.

8. Acknowledgments

The author would appreciate reviews and comments.

9. References

9.1. Normative References

[RFC4191] Draves, R. and D. Thaler, "Default Router Preferences and
           More-Specific Routes", RFC 4191, November 2005.

[RFC4861] Narten, T., Nordmark, E., Simpson, W., and H. Soliman,
           "Neighbor Discovery for IP version 6 (IPv6)", RFC 4861,
           September 2007.

9.2. Informative References

[RFC2827] Ferguson, P. and D. Senie, "Network Ingress Filtering:
           Defeating Denial of Service Attacks which employ IP Source
           Address Spoofing", BCP 38, RFC 2827, May 2000.

[RFC6724] Thaler, D., Draves, R., Matsumoto, A., and T. Chown,
           "Default Address Selection for Internet Protocol Version 6
           (IPv6)", RFC 6724, September 2012.

Author's Address

    Pierre Pfister
    Cisco Systems
    Paris
    France

    Email: pierre.pfister@darou.fr