                   IPv6 Router Advertisement Flags Option

Status of This Memo

   This document specifies an Internet standards track protocol for the
   Internet community, and requests discussion and suggestions for
   improvements. Please refer to the current edition of the "Internet
   Official Protocol Standards" (STD 1) for the standardization state
   and status of this protocol. Distribution of this memo is unlimited.

Abstract

   The IPv6 Neighbor Discovery's Router Advertisement message contains
   an 8-bit field reserved for single-bit flags. Several protocols have
   reserved flags in this field and others are preparing to reserve a
   sufficient number of flags to exhaust the field. This document
   defines an option to the Router Advertisement message that expands
   the available number of flag bits available.

Table of Contents

1. Introduction

   The IPv6 Neighbor Discovery Protocol's (NDP) [RFC4861] Router
   Advertisement message contains an 8-bit field reserved for single-bit
   flags. Several protocols have reserved flags in this field and
   others are preparing to reserve a sufficient number of flags to
   exhaust the field.

   This document defines an option for the Router Advertisement message
   that expands the available number of flag bits by adding an
   additional 48 flag bits to NDP messages.

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].

3. Current Router Advertisement Flags

   Currently, the NDP Router Advertisement message contains the
   following one-bit flags defined in published RFCs:

```
 0 1 2 3 4 5 6 7
+-+-+-+-+-+-+-+-+
|M|O|H|Prf|P|R|R|
+-+-+-+-+-+-+-+-+
```

                  Figure 1: Router Advertisement Flags

   o M - Managed Address Configuration Flag [RFC4861]

   o O - Other Configuration Flag [RFC4861]

   o H - Mobile IPv6 Home Agent Flag [RFC3775]

   o Prf - Router Selection Preferences [RFC4191]

   o P - Neighbor Discovery Proxy Flag [RFC4389]

   o R - Reserved

   With other protocols in the works (e.g., Detecting Network
   Attachment) that want to use flags in the NDP messages, it is
   necessary to define an expansion capability to support new features.

4. Flags Expansion Option

   The Neighbor Discovery specification [RFC4861] contains the
   capability to define NDP options. The following (Figure 2) is the
   definition of the Expanded Flags Option (EFO) for NDP Router
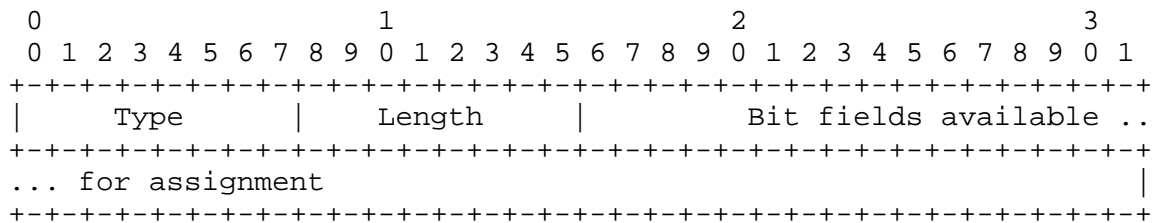   Advertisement messages.

```
    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     |        Bit fields available ..
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   ... for assignment                                             |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

            Figure 2: Router Advertisement Expanded Flags Option

   o Type - TBD (to be assigned by IANA)

   o Length - The length MUST be checked when processing the option in
      order to allow for future expansion of this option. An
      implementation of this specification MUST set the Length to 1,
      MUST ignore any unrecognized data, and MUST be able to recognize
      the specific length in order to skip over unrecognized bits.

   o Bits - allocated by IANA

   The definition and usage of these bits is to be found in the document
   requesting their allocation.

   During the construction/transmission, this option:

   o MUST only occur in Router Advertisement messages.

   o MUST occur prior to any additional options associated with any
      flags set in this option.

   o MUST only occur once in the Router Advertisement message.

   o MUST NOT be added to a Router Advertisement message if no flags in
      the option are set.

   o MUST set all unused flags to zero.

Upon reception, a receiver processing NDP messages containing this
option:

o MUST ignore the option if it occurs in a message other than a
   Router Advertisement.

o MUST ignore all instances of the option except the first one
   encountered in the Router Advertisement message.

o MUST ignore the option if the Length is less than 1.

o MUST ignore any unknown flag bits.

The bit fields within the option are numbered from left to right,
from 8 to 55 (starting as bit offset 16 in the option) and follow the
numbering of the flag bits in the RA option described in Figure 1.
Flag bits 0 to 7 are found in the Router Advertisement message header
defined in [RFC4861].

5. IANA Considerations

   IANA has defined a new IPv6 Neighbor Discovery option for the option
   defined in this document of the form:

```
        +------+--------------------------+-----------+
        | Type | Description              | Reference |
        +------+--------------------------+-----------+
        | 26   | RA Flags Extension Option | [RFC5075] |
        +------+--------------------------+-----------+
```

   The registry for these options can be found at:
   http://www.iana.org/assignments/icmpv6-parameters

   IANA has created a new registry for IPv6 ND Router Advertisement
   flags. This should include the current flags in the RA option and in
   the extension option defined in this document. The new registry has
   been added to the icmpv6-parameters as shown above. The format for
   the registry is:

```
+---------------+-----------------------------------------+-----------+
| RA Option Bit | Description                             | Reference |
+---------------+-----------------------------------------+-----------+
| 0             | M - Managed Address Configuration       | [RFC4861] |
|               | Flag                                    |           |
| 1             | O - Other Configuration Flag            | [RFC4861] |
| 2             | H - Mobile IPv6 Home Agent Flag         | [RFC3775] |
| 3             | Prf - Router Selection Preferences      | [RFC4191] |
| 4             | Prf - Router Selection Preferences      | [RFC4191] |
| 5             | P - Neighbor Discovery Proxy Flag       | [RFC4389] |
| 6-53          | R - Reserved; Available for             |           |
|               | assignment                              |           |
| 54-55         | Private Experimentation                 |           |
+---------------+-----------------------------------------+-----------+
```

   The assignment of new RA flags in the RA option header and the bits
   defined in the RA extension option defined in this document require
   standards action or IESG approval [RFC2434].

6. Security Considerations

   This protocol shares the security issues of NDP that are documented
   in the "Security Considerations" section of [RFC4861].

   The inclusion of additional optional bit fields provides a potential
   covert channel that is useful for passing information.

7. References

7.1. Normative References

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

   [RFC2434] Narten, T. and H. Alvestrand, "Guidelines for Writing an
              IANA Considerations Section in RFCs", BCP 26, RFC 2434,
              October 1998.

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

7.2. Informative References

   [RFC3775] Johnson, D., Perkins, C., and J. Arkko, "Mobility Support
              in IPv6", RFC 3775, June 2004.

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

   [RFC4389] Thaler, D., Talwar, M., and C. Patel, "Neighbor Discovery
              Proxies (ND Proxy)", RFC 4389, April 2006.

Authors' Addresses

   Brian Haberman (editor)
   Johns Hopkins University Applied Physics Lab
   11100 Johns Hopkins Road
   Laurel, MD 20723-6099
   USA

   Phone: +1 443 778 1319
   EMail: brian@innovationslab.net

   Robert Hinden
   Nokia
   313 Fairchild Drive
   Mountain View, CA 94043
   USA

   Phone: +1 650 625 2004
   EMail: bob.hinden@nokia.com

Full Copyright Statement

Intellectual Property