Network Working Group
Internet-Draft
Updates: 5175 (if approved)
Intended status: Standards Track
Expires: June 15, 2018

R. Hinden
Check Point Software
B. Carpenter
Univ. of Auckland
December 12, 2017

IPv6 Router Advertisement IPv4 Unavailable Flag
draft-hinden-ipv4flag-01

Abstract

This document specifies a Router Advertisement Flag to indicate that there is no IPv4 service on the advertising default IPv6 router. This document updates RFC5175.

Status of This Memo

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

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at http://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on June 15, 2018.

Copyright Notice

Copyright (c) 2017 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (http://trustee.ietf.org/license-info) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Table of Contents

1. Introduction

This document specifies a Router Advertisement Flag to indicate that there is no IPv4 service on the advertising default IPv6 router. The flag does not apply to non-default IPv6 routers.

Hosts that support IPv4 and IPv6, usually called dual stack hosts, need to work on IPv6 only networks. That is, a link where there are no IPv4 routers and/or IPv4 services. Monitoring of IPv6-only networks, for example at the IETF 100 meeting in Singapore, shows that current dual stack hosts will create local auto-configured IPv4 addresses and attempt to reach IPv4 services. This may be a problem for several reasons:

- It may result in an undesirable level of Layer 2 broadcast traffic, especially on large wireless networks.

- In particular, this may overload switches in multi-segment wireless networks.

- Such traffic may drain battery power on wireless hosts that have no interest in link-local IPv4 traffic. [RFC7772] indicates how this risk might be quantified.

- Similarly, hosts may waste battery power on futile attempts to access IPv4 services.

- On an IPv6-only network, IPv4 might be used for malicious purposes

and pass unnoticed by IPv6-only monitoring mechanisms.

Some of these problems could be mitigated by configuring the Layer 2 infrastructure to drop IPv4 and DHCPv4 traffic by filtering

Ethertypes 0x0800 and 0x806. However although this would limit the traffic to a single segment, it would not eliminate it.

This document defines a mechanism to inform hosts that there is no IPv4 support on their default routers so that they may choose to turn off IPv4, mitigating all of the above problems.

Because there is no IPv4 support on IPv6-only routers, the only way to notify the dual stack hosts on the link is to use an IPv6 mechanism. An active notification will be much more precise than attempting to deduce this fact by the lack of IPv4 responses or traffic.

IPv4-only hosts, and dual-stack hosts that do not recognize the new flag, will continue to attempt IPv4 operations, in particular IPv4 discovery protocols typically sent as link-layer broadcasts. This legacy traffic cannot be prevented by any IPv6 mechanism. The value of the new flag is limited to dual-stack hosts that recognize it.

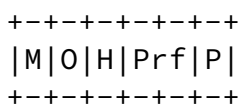
Additionally, dual-stack hosts that support any form of link-local service may choose to support such a service over IPv4 regardless of the new mechanism. Similarly, it is possible that a network could be configured with both IPv6-only routers and IPv4-only routers. For that reason, the new mechanism is advisory in nature. Host behaviors are discussed in more detail in Section 4.

This document specifies a new flag for IPv6 Neighbor Discovery [RFC4861] Router Advertisement Flag [RFC5175]. It updates [RFC5175].

2. IPv4 Unavailable Flag

RFC5175 currently defines the flags in the NDP Router Advertisement message. This currently contains the following one-bit flags defined in published RFCs:

```
    0 1 2 3 4 5 6 7
```



M Managed Address Configuration Flag [RFC4861]
O Other Configuration Flag [RFC4861]
H Mobile IPv6 Home Agent Flag [RFC3775]
Prf Router Selection Preferences [RFC4191]
P Neighbor Discovery Proxy Flag [RFC4389]
R Reserved

This document defines bit 6 to be the IPv4 Unavailable Flag:

4 IPv4 Unavailable Flag [RFC4861]

This flag has two values. These are:

0 IPv4 is Available on this default Router
1 IPv4 is Not Available on this default Router

RFC 5175 requires that unused flag bits be set to zero. Therefore, a router that does not support the new flag will not appear to assert that IPv4 is unsupported.

Hosts receiving the Router Advertisement should only process this flag if the advertising router is a Default Router. Specifically, if the Lifetime field in the Router Advertisement is not zero, otherwise it should be ignored. This is done to allow some IPv6 routers to advertise information without being a Default Router and providing IPv6 connectivity.

3. Router and Operational Considerations

Default IPv6 routers that do not support IPv4 should be configured to set the IPv4 Unavailable flag to 1, unless the operator is aware that IPv4 support is available from another router. Default IPv6 routers

that also support IPv4 must set the IPv4 Unavailable flag to 0.

Operators of large IPv6-only wireless networks are advised to use Layer 2 techniques to drop IPv4 and DHCPv4 packets (Ethertypes 0x0800 and 0x806) at all switches, and to ensure that IPv4 and DHCPv4 Layer 3 features are disabled in all switches.

4. Host Behavior Considerations

As noted above, the IPv4 Unavailable flag is advisory. Hosts may vary in their treatment of it.

A host may choose to delay all IPv4 operations at start-up until a reasonable time has elapsed for RA messages to arrive.

If there are multiple IPv6 default routers on a network, they might send different values of the flag. If at least one IPv6 default router sends the flag with value 0, a dual stack host should assume that IPv4 is available. If all IPv6 default routers send the flag

with value 1, a dual stack host may assume that IPv4 is not available.

A host that receives only RAs with the flag set to 1 may choose not to attempt any IPv4 operations, unless it subsequently receives at least one RA with the flag set to zero. As soon as such an RA is received, IPv4 operations should be started.

Alternatively, a host that receives only RAs with the flag set to 1 may choose to attempt IPv4 operations but at significantly lower frequency than normal. For example, it may choose to lengthen the interval between DHCPv4 discovery messages to much longer than the 64 seconds defined by [RFC2131].

A host that receives only RAs with the flag set to 1 may choose not to form an IPv4 link-local address. However, as noted above, if it contains link-local applications that can use IPv4, it may instead choose to form an IPv4 link-local address in the normal way [RFC3927], and then send the discovery traffic for such applications.

In all of the above, the flag's value is considered valid for the lifetime of the default router concerned, unless a subsequent RA

delivers a different flag value. If a default router expires (i.e., no RA is received that refreshes its lifetime), the host must remove this router's flag value from consideration. If the result is that all surviving default routers have the flag set to 1, the host may now assume that IPv4 is not available. In other words, at any given time, the state of the flag as seen by the host is the logical AND of the flags sent by all unexpired default IPv6 routers.

5. IANA Considerations

IANA is requested to assign the new Router Advertisement flag defined in Section 2 of this document. Bit 6 is the next available bit in this registry, IANA is requested to use this bit unless there is a reason not to use this bit.

IANA should also register this new flag bit in IANA IPv6 ND Router Advertisement flags Registry [IANA-RF].

6. Security Considerations

This document shares the security issues with other parts of IPv6 Neighbor Discovery. General techniques to protect Router Advertisement traffic such as Router Guard [RFC6105] are useful in protecting these vulnerabilities.

A bad actor could use this mechanism to attempt turn off IPv4 service on a network that is using IPv4, by sending Router Advertisements with the IPv4 Unavailable Flag set to 1. In that case, as long as there are routers sending Router Advertisements with this Flag set to 0, they would override this attack given the mechanism in Section 2. Specifically a host would only turn off IPv4 service if it wasn't hearing any Router Advertisement with the Flag set to 0. If the advice in Section 3 is followed, this attack will fail.

Conversely, a bad actor could use this mechanism to turn on, or pretend to turn on, IPv4 service on an IPv6-only network, by sending Router Advertisements with the Flag set to 0. However, this is really no different than what such a bad actor can do anyway, if they have the ability to configure a bogus router in the first place. The advice in Section 3 will minimize such an attack by limiting it to a

single network segment.

Note that manipulating the Router Preference [RFC4191] will not affect either of these attacks: any IPv4 Unavailable Flag of 0 will always override all Flags set to 1.

The new flag is neutral from an IPv6 privacy viewpoint, since it does not affect IPv6 operations in any way. From an IPv4 privacy viewpoint, it has the potential benefit of suppressing unnecessary traffic that might reveal the existence of a host and the correlation between its hardware and IPv4 addresses.

7. Acknowledgments

A closely related proposal was published earlier as [I-D.ietf-sunset4-noipv4].

Helpful comments were received from Lorenzo Colitti, David Farmer, Fernando Gont, Erik Kline, Jen Linkova, Michael Richardson, James Woodyatt, and other members of the 6MAN working group.

8. Change log [RFC Editor: Please remove]

draft-hinden-ipv4flag-01, 2017-12-12

Inverted name of flag from "Available" to "Unavailable".

Added problem description and clarified scope.

Added router and operational considerations.

Added host behavior considerations.

Extended security considerations.

Added Acknowledgment section, including reference to prior sunset4 draft.

draft-hinden-ipv4flag-00, 2017-11-17:

Original version.

9. References

9.1. Normative References

[IANA-RF] "IPv6 ND Router Advertisement flags", <https://www.iana.org/assignments/icmpv6-parameters/icmpv6-parameters.xhtml#icmpv6-parameters-11>.

[RFC2131] Droms, R., "Dynamic Host Configuration Protocol", RFC 2131, DOI 10.17487/RFC2131, March 1997, <https://www.rfc-editor.org/info/rfc2131>.

[RFC3927] Cheshire, S., Aboba, B., and E. Guttman, "Dynamic Configuration of IPv4 Link-Local Addresses", RFC 3927, DOI 10.17487/RFC3927, May 2005, <https://www.rfc-editor.org/info/rfc3927>.

[RFC4191] Draves, R. and D. Thaler, "Default Router Preferences and More-Specific Routes", RFC 4191, DOI 10.17487/RFC4191, November 2005, <https://www.rfc-editor.org/info/rfc4191>.

[RFC4861] Narten, T., Nordmark, E., Simpson, W., and H. Soliman, "Neighbor Discovery for IP version 6 (IPv6)", RFC 4861, DOI 10.17487/RFC4861, September 2007, <https://www.rfc-editor.org/info/rfc4861>.

[RFC5175] Haberman, B., Ed. and R. Hinden, "IPv6 Router Advertisement Flags Option", RFC 5175, DOI 10.17487/RFC5175, March 2008, <https://www.rfc-editor.org/info/rfc5175>.

9.2. Informative References

[I-D.ietf-sunset4-noipv4]
Perreault, S., George, W., Tsou, T., Yang, T., and J. Tremblay, "Turning off IPv4 Using DHCPv6 or Router Advertisements", draft-ietf-sunset4-noipv4-01 (work in progress), December 2014.

[RFC6105] Levy-Abegnoli, E., Van de Velde, G., Popoviciu, C., and J.

Mohacsi, "IPv6 Router Advertisement Guard", RFC 6105, DOI 10.17487/RFC6105, February 2011, <https://www.rfc-editor.org/info/rfc6105>.

[RFC7772] Yourtchenko, A. and L. Colitti, "Reducing Energy Consumption of Router Advertisements", BCP 202, RFC 7772, DOI 10.17487/RFC7772, February 2016, <https://www.rfc-editor.org/info/rfc7772>.

Authors' Addresses

Robert M. Hinden
Check Point Software
959 Skyway Road
San Carlos, CA 94070
USA

Email: bob.hinden@gmail.com

Brian Carpenter
Department of Computer Science
University of Auckland
PB 92019
Auckland 1142
New Zealand

Email: brian.e.carpenter@gmail.com