Internet Engineering Task Force (IETF)
Request for Comments: 8319
Updates: 4861
Category: Standards Track
ISSN: 2070-1721

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February 2018

Support for Adjustable Maximum Router Lifetimes per Link

Abstract

The IPv6 Neighbor Discovery protocol specifies the maximum time allowed between sending unsolicited multicast Router Advertisements (RAs) from a router interface as well as the maximum router lifetime. It also allows the limits to be overridden by documents that are specific to the link layer. This document allows for overriding these values on a per-link basis.

This document specifies updates to the IPv6 Neighbor Discovery Protocol (RFC 4861) to increase the maximum time allowed between sending unsolicited multicast RAs from a router interface as well as to increase the maximum router lifetime.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at https://www.rfc-editor.org/info/rfc8319.

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1. Introduction

IPv6 Neighbor Discovery relies on IP multicast based on the expectation that multicast makes efficient use of available bandwidth and avoids generating interrupts in the network nodes. On some data link layers, multicast may not be natively supported. On such links, any possible reduction of multicast traffic will be highly beneficial. Unfortunately, due to the fixed protocol constants specified in [RFC4861], it is difficult to relax the multicast timers for Neighbor Discovery. There are already clarifications specific to the link technology about how to tune the Neighbor Discovery Protocol (NDP) constants for certain systems in order to reduce excess NDP traffic. For example, [RFC6459] and [RFC7066] contain such clarifications for 3GPP cellular links.

This document specifies updates to the IPv6 Neighbor Discovery Protocol [RFC4861] to increase the maximum time allowed between sending unsolicited multicast RAs from a router interface as well as to increase the maximum router lifetime.

2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

3. Relationship between AdvDefaultLifetime and MaxRtrAdvInterval

MaxRtrAdvInterval is an upper bound on the time between which two successive Router Advertisement messages are sent. Therefore, one might reason about the relationship between these two values in terms of a ratio K = AdvDefaultLifetime / MaxRtrAdvInterval, which expresses how many Router Advertisements are guaranteed to be sent before the router lifetime expires.

Assuming unicast Solicited Router Advertisements or a perfectly stable network, on a theoretically perfect link with no losses, it would be sufficient to have K just above 1, so that the sent Router Advertisement refreshes the router entry just before it expires. On the real links that allow for some loss, one would need to use K > 2 in order to minimize the chances of a single Router Advertisement loss causing a loss of the router entry.

The exact calculation will depend on the packet loss probability. An example: if we take a ballpark value of 1% probability of a packet loss, then K = 2 will give 0.01% chance of an outage due to a packet loss, K = 3 will give 0.0001% chance of an outage, and so forth. To reverse the numbers, with these parameters, K ~= 1 gives 99% reliability, K ~= 2 gives 99.99% reliability, and K ~= 3 gives 99.9999% reliability -- which should be good enough for a lot of scenarios.

In a network with higher packet loss probabilities or if higher reliability is desired, the K might be chosen to be even higher. On the other hand, some of the data link layers provide reliable delivery at Layer 2, so there one might even consider using the "theoretical" value of K just above 1. Since the choice of these two parameters does not impact interoperability per se, this document does not impose any specific constraints on their values other than providing the guidelines in this section. Therefore, each individual link can optimize according to its use case.

Also, AdvDefaultLifetime MUST be set to a value greater than or equal to the selected MaxRtrAdvInterval. Otherwise, a router lifetime is guaranteed to expire before the new Router Advertisement has a chance to be sent, thereby creating an outage.

4. Updates to RFC 4861

This document updates Sections 4.2 and 6.2.1 of [RFC4861] to change the following router configuration variables.

In Section 4.2, inside the paragraph that defines Router Lifetime, change 9000 to 65535 seconds.

In Section 6.2.1, inside the paragraph that defines MaxRtrAdvInterval, change 1800 to 65535 seconds.

In Section 6.2.1, inside the paragraph that defines AdvDefaultLifetime, change 9000 to 65535 seconds.

As explained in Section 3, the probability of packet loss must be considered when choosing the relationship between MaxRtrAdvInterval and AdvDefaultLifetime.

5. Host Behavior

Legacy hosts on a link with updated routers may have issues with a Router Lifetime of more than 9000 seconds. In the few implementations we have tested with general-purpose operating systems, there does not seem to be any issue with setting this field to more than 9000, but there might be implementations that incorrectly reject such RAs (since RFC 4861 requires receivers to handle any value).

6. Security Considerations

On a link where Router Advertisements are few and far between, the detrimental effects of a rogue router that sends an unsolicited RA are greatly increased. These rogue RAs can be prevented by using approaches like RA-Guard [RFC6105] and SEcure Neighbor Discovery (SEND) [RFC3971].

7. IANA Considerations

This document has no IANA actions.

8. References

8.1. Normative References

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Acknowledgements

The authors would like to thank the members of the 6MAN efficient ND design team for their comments that led to the creation of this document. The authors would also like to thank Lorenzo Colitti, Erik Kline, Jeena Rachel John, Brian Carpenter, Tim Chown, Fernando Gont, Warren Kumari, and Adam Roach for their comments and suggestions that improved this document.

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