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F. Gont
SI6 Networks
J. Zorz
Go6 Institute
R. Patterson
Sky UK

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Improving the Robustness of Stateless Address Autoconfiguration (SLAAC) to Flash Renumbering Events

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Abstract

In renumbering scenarios where an IPv6 prefix suddenly becomes invalid, hosts on the local network will continue using stale prefixes for an unacceptably long period of time, thus resulting in connectivity problems. This document improves the reaction of IPv6 Stateless Address Autoconfiguration to such renumbering scenarios.

Status of This Memo

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1. Introduction

IPv6 network renumbering is expected to take place in a planned manner, with old/stale prefixes being phased-out via reduced prefix lifetimes while new prefixes (with normal lifetimes) are introduced. However, there are a number of scenarios that may lead to the so-called "flash-renumbering" events, where the prefix being employed on a network suddenly becomes invalid and replaced by a new prefix [I-D.ietf-v6ops-slaac-renum]. In such scenarios, hosts on the local network will continue using stale prefixes for an unacceptably long period of time, thus resulting in connectivity problems. [I-D.ietf-v6ops-slaac-renum] discusses this problem in detail.

In some scenarios, the local router producing the network renumbering event may try to deprecate the currently-employed prefixes (thus explicitly signaling the network about the renumbering event), whereas in other scenarios it may be unaware about the renumbering event and thus unable signal hosts about it.

From the perspective of a Stateless Address Autoconfiguration (SLAAC) host, there are two different (but related) problems to be solved:

- Avoiding the use of stale addresses for new communication instances
- Performing "garbage collection" for the stale prefixes (and related network configuration information)

Clearly, if a host has both working and stale addresses, it is paramount that it employs working addresses for new communication instances. Additionally, a host should also perform garbage collection for the stale prefixes/addresses, since they not only tie system resources, but also prevent communication with the new "owners" of the stale prefixes.

2. Terminology

The term "globally reachable" is used in this document as defined in [RFC8190].

The term "Global Unicast Address" (or its acronym "GUA") is used throughout this document to refer to "globally reachable" [RFC8190] addresses. That is, when used throughout this document, GUAs do NOT include Unique Local Addresses (ULAs) [RFC4193]. Similarly, the term "Global Unicast prefix" (or "GUA prefix") is employed throughout this document to refer to network prefixes that specify GUAs, and does NOT include the ULA prefix (FC00::/7) [RFC4193].

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. SLAAC reaction to Flash-renumbering Events

As noted in Section 1, in some scenarios the router triggering the renumbering event may be able to explicitly signal the network about this event, while in other scenarios the renumbered hosts may need to infer a renumbering event is taking place. The following subsections analyze specific considerations for each of these scenarios.

3.1. Renumbering without Explicit Signaling

In the absence of explicit signalling from SLAAC routers (such as sending Prefix Information Options (PIOs) with small lifetimes to deprecate the stale prefixes), stale prefixes will remain preferred and valid according to the Preferred Lifetime and Valid Lifetime values (respectively) of the last received PIO. IPv6 SLAAC employs the following default values for PIOs:

- Preferred Lifetime (AdvPreferredLifetime): 604800 seconds (7 days)

- Valid Lifetime (AdvValidLifetime): 2592000 seconds (30 days)

This means that, in the absence of explicit signaling by a SLAAC router to deprecate a prefix, it will take a host 7 days (one week) to deprecate the corresponding addresses, and 30 days (one month) to eventually remove any addresses configured for the stale prefix. Clearly, for any practical purposes, employing such long default values is the equivalent of not using any timers at all, since taking 7 days or 30 days (respectively) to recover from a network problem is simply unacceptable.

Use of more appropriate timers in Router Advertisement messages can help limit the amount of time that hosts will maintain stale configuration information. Additionally, hosts are normally in a position to infer that a prefix has become stale -- for example, if a given router ceases to advertise an existing prefix and at the same time starts to advertise a new prefix.

Section 4.1.1 recommends the use of more appropriate lifetimes for PIOs, while Section 4.1.2 proposes to cap the accepted Valid Lifetime and Preferred Lifetime values at hosts, such that more appropriate values are employed even in the presence of legacy routers.

Section 4.5 specifies a local policy that SLAAC hosts can implement to heuristically infer that network configuration information has changed, such that stale configuration information can be phased out.

3.2. Renumbering with Explicit Signaling

In scenarios where a local router is aware about the renumbering event, it may try to phase out the stale network configuration information. In these scenarios, there are two aspects to be considered:

- The amount of time during which the router should continue trying to deprecate the stale network configuration information
- The ability of SLAAC hosts to phase out stale configuration in a timelier manner.

In the absence of Router Advertisements (RAs) that include PIOs that would reduce the Valid Lifetime and Preferred Lifetime of a prefix, hosts would normally employ the lifetime values from PIO options of the last received RA messages. Since the network could be partitioned for an arbitrarily long period of time, a router would need to try to deprecate a prefix for the amount of time employed for the "Preferred Lifetime", and try to invalidate the prefix for the amount of time employed for the "Valid Lifetime" (see Section 12 of [RFC4861]).

NOTE:
Once the number of seconds in the original "Preferred Lifetime" have elapsed, all hosts would have deprecated the corresponding addresses anyway, while once the number of seconds in the "Valid Lifetime" have elapsed, the corresponding addresses would be invalidated and removed.

Thus, use of more appropriate default lifetimes for PIOs, as proposed in Section 4.1.1, would reduce the amount of time a stale prefix would need to be announced as such by a router in order to make sure that it is deprecated/invalidated.

In scenarios where a router has positive knowledge that a prefix has become invalid and thus could signal this condition to local hosts, the current specifications will prevent SLAAC hosts from fully recovering from such stale information. Item "e)" of Section 5.5.3 of [RFC4862] specifies that an RA may never reduce the "RemainingLifetime" to less than two hours. Additionally, if the RemainingLifetime of an address is smaller than 2 hours, then a Valid Lifetime smaller than 2 hours will be ignored. The inability to invalidate a stale prefix would prevent communication with the new

"owners" of the stale prefix, and thus is highly undesirable. On the other hand, the Preferred Lifetime of an address *can* be reduced to any value to avoid the use of a stale prefix for new communications.

Section 4.2 updates [RFC4862] such that this restriction in removed, and hosts react to the advertised "Valid Lifetime" (even if it is smaller than 2 hours).

Finally, Section 4.3 recommends that routers disseminate network configuration information when a network interface is initialized, such that possibly new configuration information propagates in a timelier manner.

4. Improvements to Stateless Address Autoconfiguration (SLAAC)

The following subsections update [RFC4861] and [RFC4862], such that the problem discussed in this document is mitigated. The aforementioned updates are mostly orthogonal, and mitigate different aspects of SLAAC that prevent a timely reaction to flash renumbering events.

- Reduce the default Valid Lifetime and Preferred Lifetime of PIOs (Section 4.1.1):
  This helps limit the amount of time a host will employ stale information, and also limits the amount of time a router needs to try to obsolete stale information.

- Cap the received Valid Lifetime and Preferred Lifetime of PIOs (Section 4.1.2):
  This helps limit the amount of time a host will employ stale information, even in the presence of legacy ([RFC4861]) routers.

- Honor PIOs with small Valid Lifetimes (Section 4.2):
  This allows routers to invalidate stale prefixes, since otherwise [RFC4861] prevents hosts from honoring PIOs with a Valid Lifetime smaller than two hours.

- Recommend routers to retransmit configuration information upon interface initialization/reinitialization (Section 4.3):
  This helps spread the new information in a timelier manner, and also deprecate stale information via host-side heuristics (see Section 4.5).

- Recommend routers to always send all options (i.e. the complete configuration information) in RA messages, and in the smallest possible number of packets (Section 4.4):

This helps propagate the same information to all hosts, and also allows hosts to better infer that information missing in RA messages has become stale (see Section 4.5).

- Infer stale network configuration information from received RAs (Section 4.5):
  This allows hosts to deprecate stale network configuration information, even in the absence of explicit signaling.

4.1. More Appropriate Lifetime Values

4.1.1. Router Configuration Variables

[TBD]

4.1.2. Processing of PIO Lifetimes at Hosts

[TBD]

4.2. Honor Small PIO Valid Lifetimes

[TBD]

4.3. Interface Initialization

[TBD]

4.4. Conveying Information in Router Advertisement (RA) Messages

[TBD]

4.5. Recovery from Stale Configuration Information without Explicit Signaling

[TBD]

5. IANA Considerations

This document has no actions for IANA.

6. Implementation Status

[NOTE: This section is to be removed by the RFC-Editor before this document is published as an RFC.]

This section summarizes the implementation status of the updates proposed in this document. In some cases, they correspond to variants of the mitigations proposed in this document (e.g., use of

reduced default lifetimes for PIOs, albeit using different values than those recommended in this document). In such cases, we believe these implementations signal the intent to deal with the problems described in [I-D.ietf-v6ops-slaac-renum] while lacking any guidance on the best possible approach to do it.

6.1. More Appropriate Lifetime Values

6.1.1. Router Configuration Variables

6.1.1.1. rad(8)

We have produced a patch for OpenBSD's rad(8) [rad] that employs the default lifetimes recommended in this document, albeit it has not yet been committed to the tree. The patch is available at: <https://www.gont.com.ar/code/fgont-patch-rad-pio-lifetimes.txt>.

6.1.1.2. radvd(8)

The radvd(8) daemon [radvd], normally employed by Linux-based router implementations, currently employs different default lifetimes than those recommended in [RFC4861]. radvd(8) employs the following default values [radvd.conf]:

- Preferred Lifetime: 14400 seconds (4 hours)

- Valid Lifetime: 86400 seconds (1 day)

This is not following the specific recommendation in this document, bu is already a deviation from the current standards.

6.1.2. Processing of PIO Lifetimes at Hosts

6.1.2.1. NetworkManager

NetworkManager [NetworkManager], user-space SLAAC implementation employed by some Linux-based operating systems (such as Fedora or Ubuntu), caps the lifetimes of the received PIOs as recommended in this document.

6.1.2.2. slaacd(8)

slaacd(8) [slaacd], a user-space SLAAC implementation employed by OpenBSD, caps the lifetimes of the received PIOs as recommended in this document.

6.1.2.3. systemd-networkd

systemd-networkd [systemd], a user-space SLAAC implementation employed by some Linux-based operating systems, caps the lifetimes of the received PIOs as recommended in this document.

6.2. Honor Small PIO Valid Lifetimes

6.2.1. NetworkManager

NetworkManager [NetworkManager] processes RA messages with a Valid Lifetime smaller than two hours as recommended in this document.

6.3. Conveying Information in Router Advertisement (RA) Messages

We know of no implementation that splits network configuration information into multiple RA messages.

6.4. Recovery from Stale Configuration Information without Explicit Signaling

6.4.1. dhcpcd(8)

The dhcpcd(8) daemon [dhcpcd], a user-space SLAAC implementation employed by some Linux-based and BSD-derived operating systems, will set the Preferred Lifetime of addresses corresponding to a given prefix to 0 when a single RA from the router that previously advertised the prefix fails to advertise the corresponding prefix. However, it does not affect the corresponding Valid Lifetime. Therefore, it can be considered a partial implementation of this feature.

6.5. Other mitigations implemented in products

[FRITZ] is a Customer Edge Router that tries to deprecate stale prefixes by advertising stale prefixes with a Preferred Lifetime of 0, and a Valid Lifetime of 2 hours (or less). There are two things to note with respect to this implementation:

- Rather than recording prefixes on stable storage (as recommended in [I-D.ietf-v6ops-cpe-slaac-renum]), this implementation checks the source address of IPv6 packets, and assumes that usage of any address that does not correspond to a prefix currently-advertised by the Customer Edge Router is the result of stale network configuration information. Hence, upon receipt of a packet that employs a source address that does not correspond to a currently-advertised prefix, this implementation will start advertising the

corresponding prefix with small lifetimes, with the intent of deprecating it.

- Possibly as a result of item "e)" (pp. 19-20) from Section 5.5.3 of [RFC4862] (discussed in Section 4.2 of this document), upon first occurrence of a stale prefix, this implementation will employ a decreasing Valid Lifetime, starting from 2 hours (7200 seconds), as opposed to a Valid Lifetime of 0.

7. Security Considerations

When it comes to the algorithm in Section 4.5, an attacker could impersonate the legitimate router and send an RA that does not advertise legitimate prefixes being employed in the local network. This cause the corresponding addresses to become deprecated. However, the addresses would not become invalid since normal unsolicited RA messages would refresh the "Preferred Lifetime" and "Valid Lifetime" of such addresses.

However, an attacker that can impersonate a router could more easily deprecate addresses by advertising the legitimate prefixes with the "Preferred Lifetime" set to 0, or perform a plethora of other possible of Denial of Service attacks based on forged RA messages. Therefore, when attacks based on forged RA packets are a concern, technologies such as RA-Guard [RFC6105] [RFC7113] should be deployed.

Capping the "Valid Lifetime" and "Preferred Lifetime" at hosts may help limit the duration of the effects of non-sustained attacks that employ forged RAs with PIOs, since hosts would now recover in a timelier manner.

8. Acknowledgments

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Fernando would also like to thank Brian Carpenter who, over the years, has answered many questions and provided valuable comments that has benefited his protocol-related work.

The problem discussed in this document has been previously documented by Jen Linkova in [I-D.linkova-6man-default-addr-selection-update], and also in [RIPE-690].

9. References

9.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC4193] Hinden, R. and B. Haberman, "Unique Local IPv6 Unicast Addresses", RFC 4193, DOI 10.17487/RFC4193, October 2005, <https://www.rfc-editor.org/info/rfc4193>.

[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>.

[RFC4862] Thomson, S., Narten, T., and T. Jinmei, "IPv6 Stateless Address Autoconfiguration", RFC 4862, DOI 10.17487/RFC4862, September 2007, <https://www.rfc-editor.org/info/rfc4862>.

[RFC8028] Baker, F. and B. Carpenter, "First-Hop Router Selection by Hosts in a Multi-Prefix Network", RFC 8028, DOI 10.17487/RFC8028, November 2016, <https://www.rfc-editor.org/info/rfc8028>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

[RFC8190] Bonica, R., Cotton, M., Haberman, B., and L. Vegoda, "Updates to the Special-Purpose IP Address Registries", BCP 153, RFC 8190, DOI 10.17487/RFC8190, June 2017, <https://www.rfc-editor.org/info/rfc8190>.

[RFC8504] Chown, T., Loughney, J., and T. Winters, "IPv6 Node Requirements", BCP 220, RFC 8504, DOI 10.17487/RFC8504, January 2019, <https://www.rfc-editor.org/info/rfc8504>.

9.2. Informative References

[dhcpcd] Marples, R., "dhcpcd - a DHCP client", <https://roy.marples.name/projects/dhcpcd/>.

[FRITZ] Gont, F., "Quiz: Weird IPv6 Traffic on the Local Network (updated with solution)", SI6 Networks Blog, February 2016, <http://blog.si6networks.com/2016/02/quiz-weird-ipv6-traffic-on-local-network.html>.

[I-D.ietf-v6ops-cpe-slaac-renum] Gont, F., Zorz, J., Patterson, R., and B. Volz, "Improving the Reaction of Customer Edge Routers to Renumbering Events", draft-ietf-v6ops-cpe-slaac-renum-03 (work in progress), May 2020.

[I-D.ietf-v6ops-slaac-renum] Gont, F., Zorz, J., and R. Patterson, "Reaction of Stateless Address Autoconfiguration (SLAAC) to Flash-Renumbering Events", draft-ietf-v6ops-slaac-renum-02 (work in progress), May 2020.

[I-D.linkova-6man-default-addr-selection-update] Linkova, J., "Default Address Selection and Subnet Renumbering", draft-linkova-6man-default-addr-selection-update-00 (work in progress), March 2017.

[NetworkManager] NetworkManager, "NetworkManager web site", <https://wiki.gnome.org/Projects/NetworkManager>.

[rad] Obser, F., "OpenBSD Router Advertisement Daemon - rad(8)", <https://cvsweb.openbsd.org/src/usr.sbin/rad/>.

[radvd] Hawkins, R. and R. Johnson, "Linux IPv6 Router Advertisement Daemon (radvd)", <http://www.litech.org/radvd/>.

[radvd.conf] Hawkins, R. and R. Johnson, "radvd.conf - configuration file of the router advertisement daemon", <https://github.com/reubenhwk/radvd/blob/master/radvd.conf.5.man>.

[RFC2827] Ferguson, P. and D. Senie, "Network Ingress Filtering: Defeating Denial of Service Attacks which employ IP Source Address Spoofing", BCP 38, RFC 2827, DOI 10.17487/RFC2827, May 2000, <https://www.rfc-editor.org/info/rfc2827>.

[RFC5927] Gont, F., "ICMP Attacks against TCP", RFC 5927, DOI 10.17487/RFC5927, July 2010, <https://www.rfc-editor.org/info/rfc5927>.

[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>.

[RFC6724] Thaler, D., Ed., Draves, R., Matsumoto, A., and T. Chown, "Default Address Selection for Internet Protocol Version 6 (IPv6)", RFC 6724, DOI 10.17487/RFC6724, September 2012, <https://www.rfc-editor.org/info/rfc6724>.

[RFC7113] Gont, F., "Implementation Advice for IPv6 Router Advertisement Guard (RA-Guard)", RFC 7113, DOI 10.17487/RFC7113, February 2014, <https://www.rfc-editor.org/info/rfc7113>.

[RIPE-690] Zorz, J., Zorz, S., Drazumeric, P., Townsley, M., Alston, J., Doering, G., Palet, J., Linkova, J., Balbinot, L., Meynell, K., and L. Howard, "Best Current Operational Practice for Operators: IPv6 prefix assignment for end-users - persistent vs non-persistent, and what size to choose", RIPE 690, October 2017, <https://www.ripe.net/publications/docs/ripe-690>.

[slaacd] Obser, F., "OpenBSD SLAAC Daemon - slaacd(8)", <https://cvsweb.openbsd.org/src/usr.sbin/slaacd/>.

[systemd] systemd, "systemd web site", <https://systemd.io/>.

Appendix A. Analysis of Some Suggested Workarounds

[This section is to be removed before publication of this document as an RFC].

During the discussion of this document, some alternative workarounds were suggested on the 6man mailing-list. The following subsections analyze these suggested workarounds, in the hopes of avoiding rehashing the same discussions.

A.1. On a Possible Reaction to ICMPv6 Error Messages

It has been suggested that if configured addresses become stale, a CPE enforcing ingress/egress filtering (BCP38) ([RFC2827]) could send ICMPv6 Type 1 (Destination Unreachable) Code 5 (Source address failed ingress/egress policy) error messages to the sending node, and that, upon receipt of such error messages, the sending node could perform heuristics that might help to mitigate the problem discussed in this document.

The aforementioned proposal has a number of drawbacks and limitations:

- It assumes that the CPE routers enforce ingress/egress filtering [RFC2827]. While this is desirable behaviour, it cannot be relied upon.

- It assumes that if the CPE enforces ingress/egress filtering, the CPE will signal the packet drops to the sending node with ICMPv6 Type 1 (Destination Unreachable) Code 5 (Source address failed ingress/egress policy) error messages. While this may be desirable, [RFC2827] does not suggest signaling the packet drops with ICMPv6 error messages, let alone the use of specific error messages (such as Type 1 Code 5) as suggested.

- ICMPv6 Type 1 Code 5 could be interpreted as the employed address being stale, but also as a selected route being inappropriate/ suboptimal. If the later, deprecating addresses or invalidating addresses upon receipt of these error messages would be inappropriate.

- Reacting to these error messages would create a new attack vector that could be exploited from remote networks. This is of particular concern since ICMP-based attacks do not even require that the Source Address of the attack packets be spoofed [RFC5927].

A.2. On a Possible Improvement to Source Address Selection

[RFC6724] specifies source address selection (SAS) for IPv6. Conceptually, it sorts the candidate set of source addresses for a given destination, based on a number of pair-wise comparison rules that must be successively applied until there is a "winning" address.

An implementation might improve source address selection, and prefer the most-recently advertised information. In order to incorporate the "freshness" of information in source address selection, an implementation would be updated as follows:

- The node is assumed to maintain a timer/counter that is updated at least once per second. For example, the time(2) function from unix-like systems could be employed for this purpose.

- The local information associated with each prefix advertised via RAs on the local network is augmented with a "LastAdvertised" timestamp value. Whenever an RA with a PIO with the "A" bit set for such prefix is received, the "LastAdvertised" timestamp is updated with the current value of the timer/counter.

- [RFC6724] is updated such that this rule is incorporated:

  Rule 7.5: Prefer fresh information If one of the two source addresses corresponds to a prefix that has been more recently advertised, say LastAdvertised(SA) > LastAdvertised(SA), then prefer that address (SA in our case).

A clear benefit of this approach is that a host will normally prefer "fresh" addresses over possibly stale addresses.

However, there are a number of drawbacks associated with this approach:

- In scenarios where multiple prefixes are being advertised on the same LAN segment, the new SAS rule is *guaranteed* to result in non-deterministic behaviour, with hosts frequently changing the default source address. This is certainly not desirable from a troubleshooting perspective.

- Since the rule must be incorporated before "Rule 8: Use longest matching prefix" from [RFC6724], it may lead to suboptimal paths.

- This new rule may help to improve the selection of a source address, but it does not help with the housekeeping (garbage collection) of configured information:

  * If the stale prefix is re-used in another network, nodes employing stale addresses and routes for this prefix will be unable to communicate with the new "owner" of the prefix, since the stale prefix will most likely be considered "on-link".

  * Given that the currently recommended default value for the "Valid Lifetime" of PIOs is 2592000 seconds (30 days), it would take too long for hosts to remove the configured addresses and routes for the stale prefix. While the proposed update in Section 4.1 of this document would mitigate this problem, the lifetimes advertised by the local SLAAC router are not under the control of hosts.

As a result, updating IPv6 source address selection does not relieve nodes from improving their SLAAC implementations as specified in Section 4, if at all desirable. On the other hand, the algorithm specified in Section 4.5 would result in Rule 3 of [RFC6724] employing fresh addresses, without leading to non-deterministic behaviour.

Authors' Addresses

Fernando Gont
SI6 Networks
Segurola y Habana 4310, 7mo Piso
Villa Devoto, Ciudad Autonoma de Buenos Aires
Argentina

Email: fgont@si6networks.com
URI: https://www.si6networks.com

Jan Zorz
Go6 Institute
Frankovo naselje 165
Skofja Loka 4220
Slovenia

Email: jan@go6.si
URI: https://www.go6.si

Richard Patterson
Sky UK

Email: richard.patterson@sky.uk