

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

`draft-ietf-6man-slaac-renum-08`

# What is Flash-Renumbering?

Router Advertisements (used by SLAAC), contain preferred and valid lifetime parameters; these lifetimes inform clients how long they **should**, and **can** use an address for, respectively.

Flash renumbering is when the advertised prefix or address becomes invalid before the expiration of the Valid Lifetime. This may happen for several reasons, some intentional some unintentional, but it does happen.

When this happens, clients are temporarily left with broken IPv6 connectivity until they eventually renumber.

# What Causes Flash-Renumbering?

DHCPv6 is widely used for configuring broadband CPE routers. These CPE routers may crash, be manually rebooted, or the WAN-link may be unstable, all of which may trigger a renumbering event, invalidating addresses configured by SLAAC.

ISP networks often have maintenance which may require prematurely invalidating DHCPv6 leases prior to their configured lease times.

LAN-side network topology changes that do not trigger “link-down” events on end-hosts.

## SLAAC's Current Reaction

None, by default. It's up to the end-hosts to decrement and expire the timers naturally, before choosing a new address.

RFC 4861 specifies the following default values for use in RAs and subsequently by SLAAC:

- Valid Lifetime: 2592000 seconds (30 days)
- Preferred Lifetime: 604800 seconds (7 days)

If an alternative prefix is advertised, end-hosts will bind an address from that prefix, then be at the mercy of longest-match for source address selection until the Preferred Lifetime expires.

- 7 days is an excessively long time to be left with a stale address and broken connectivity
- Between 7 and 30 days, end-hosts will not be able to communicate with the new owner of the old prefix
- RFC 4862 does not currently allow a Valid Lifetime lower than 2 hours.

# What Has the IETF Done Already?

## v6ops:

- **RFC 8978**: Reaction of IPv6 Stateless Address Autoconfiguration (SLAAC) to Flash- Renumbering Events
- **RFC 9096**: Improving the Reaction of Customer Edge Routers to IPv6 Renumbering Events

## 6man:

- **draft-ietf-6man-slaac-renum**: Improving the Robustness of Stateless Address Autoconfiguration (SLAAC) to Flash Renumbering Events

# What More Can We Do?

## Update RFC 4861 - Neighbor Discovery in IPv6

[draft-ietf-6man-slaac-renum](#) proposes the following updates to RFC 4861:

- PIO Preferred Lifetime (AdvPreferredLifetime) == ND\_DEFAULT\_PREFERRED\_LIFETIME
  - Where  $ND\_DEFAULT\_PREFERRED\_LIFETIME = ND\_RAS\_PREFERRED * MaxRtrAdvInterval$
  - Using default values:  $3 * 600sec = \mathbf{30 mins}$  (decreased from 7 days)
- PIO Valid Lifetime (AdvValidLifetime) == ND\_DEFAULT\_VALID\_LIFETIME
  - Where  $ND\_DEFAULT\_VALID\_LIFETIME = ND\_RAS\_VALID * MaxRtrAdvInterval$
  - Using default values:  $8 * 600sec = \mathbf{80 mins}$  (decreased from 30 days)
- Router Lifetime (AdvDefaultLifetime) == ND\_DEFAULT\_VALID\_LIFETIME : **80 mins (increase from 30 mins)**
  - To align with recommendations from RFC 7772 - Reducing Energy Consumption of RAs

# What More Can We Do?

## Update RFC 4861 - Neighbor Discovery in IPv6

[draft-ietf-6man-slaac-renum](#) proposes the following update to RFC 4861

Section 6.2.4 - Sending Unsolicited Router Advertisements [when configuration changes]

- Upgrade MAY to MUST:

In such cases, the router ~~MAY~~ **MUST** transmit up to MAX\_INITIAL\_RTR\_ADVERTISEMENTS unsolicited advertisements, using the same rules as when an interface becomes an advertising interface.

# What More Can We Do?

## Update RFC 4861 - Neighbor Discovery in IPv6

[draft-ietf-6man-slaac-renum](#) proposes the following update to RFC 4861

### Section 6.2.3 - Router Advertisement Message Content

- Reword to encourage sending whole RAs with complete information if possible.
- Not exclude the use of multiple RAs if required.
  - E.g., multiple provisioning domains [RFC 7556], or VRRPv3 [RFC 9568].
  - Encourage the use of as few RAs as possible.



# What More Can We Do?

## Update RFC 4862 - IPv6 Stateless Address Autoconfiguration

[draft-ietf-6man-slaac-renum](#) proposes the following updates to RFC 4862

Section 5.5.3 Item e):

- Honor PIOs with Valid Lifetimes shorter than 2 hours

Current text:

If the advertised prefix is equal to the prefix of an address configured by stateless autoconfiguration in the list, the preferred lifetime of the address is reset to the Preferred Lifetime in the received advertisement. ~~The specific action to perform for the valid lifetime of the address depends on the Valid Lifetime in the received advertisement and the remaining time to the valid lifetime expiration of the previously autoconfigured address.....~~

New text:

If the advertised prefix is equal to the prefix of an address configured by stateless autoconfiguration in the list, **the valid lifetime and the preferred lifetime of the address should be updated by processing the Valid Lifetime and the Preferred Lifetime (respectively) in the received advertisement.**

# What More Can We Do?

Cite RFC 9096 - Improving the Reaction of CE Routers to IPv6 Renumbering Events

[draft-ietf-6man-slaac-renum](#) cites RFC 9096 and mandates that **all** SLAAC routers:

- Retransmit configuration information upon interface initialization/reinitialization.
- Send RAs to deprecate and invalidate any PIOs that have expired or been invalidated after a reboot or configuration update
  - Store configuration information to persistence storage, if possible.

## What More Can We Do?

Update RFC 8106 - IPv6 RA Options for DNS Configuration

Update RFC 4191 - Default Router Preferences and More-Specific Routes

[draft-ietf-6man-slaac-renum](#) proposes the following updates to RFC 8106 & 4191:

- RDNSS Option Lifetime == ND\_DEFAULT\_VALID\_LIFETIME : **80 mins (increase from 30 mins)**
- DNS Search List Option Lifetime == ND\_DEFAULT\_VALID\_LIFETIME : **80 mins (increase from 30 mins)**
- RIO Route Lifetime == ND\_DEFAULT\_VALID\_LIFETIME : **80 mins (increase from 30 mins?)**
  - No default value currently defined. Implementations presumably inherit from AdvDefaultLifetime

# What More Can We Do?

Assist in selecting non-default values

[draft-ietf-6man-slaac-renum](#) provides a reliability table based on loss probability:

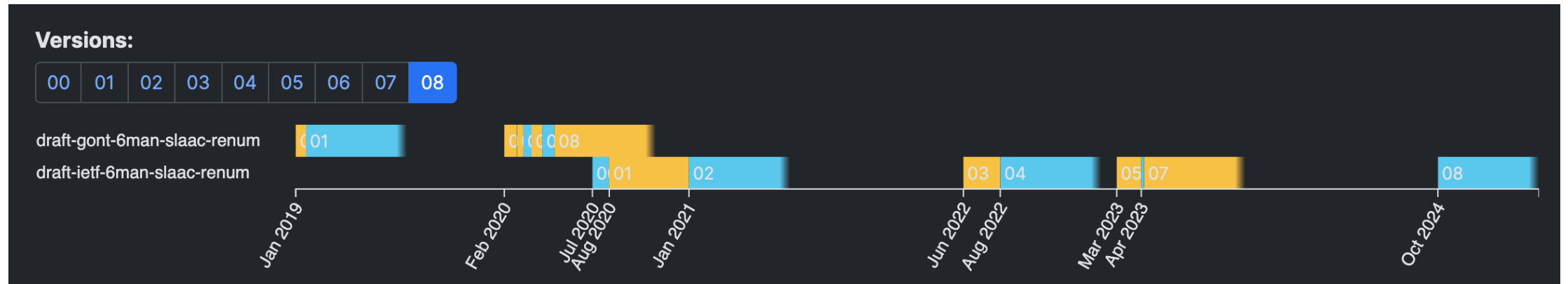
- To aid administrators of unreliable networks, or devices, in selecting non-default ND\_RAS\_PREFERRED and ND\_RAS\_VALID values.
- E.g., with a loss rate of 10% one in 6 RAs are likely to be received

The following table tabulates the probability of receiving at least one RA message (P) for a combination of "n" (number of RA messages sent) and Loss (Loss rate for multicasted RA messages):

| n / Loss | 0.10    | 0.20    | 0.30    | 0.40    | 0.50    | 0.60    |
|----------|---------|---------|---------|---------|---------|---------|
| 3        | 0.99900 | 0.99200 | 0.97300 | 0.93600 | 0.87500 | 0.78400 |
| 4        | 0.99990 | 0.99840 | 0.99190 | 0.97440 | 0.93750 | 0.87040 |
| 5        | 0.99999 | 0.99968 | 0.99757 | 0.98976 | 0.96875 | 0.92224 |
| 6        | 1.00000 | 0.99994 | 0.99927 | 0.99590 | 0.98437 | 0.95334 |
| 7        | 1.00000 | 0.99999 | 0.99978 | 0.99836 | 0.99219 | 0.97201 |
| 8        | 1.00000 | 1.00000 | 0.99993 | 0.99934 | 0.99609 | 0.98320 |
| 9        | 1.00000 | 1.00000 | 0.99998 | 0.99974 | 0.99805 | 0.98992 |
| 10       | 1.00000 | 1.00000 | 0.99999 | 0.99989 | 0.99902 | 0.99395 |

Table 1: Sample values for  $P = 1 - (Loss)^n$

# History of draft-ietf-6man-slaac-renum



- July 2020 - Adopted by 6man
- Sept 2023 – WGLC
- .....
- Nov 2023 – Expired
- Oct 2024 – Revision 08 published
- Next Steps – WG to review, please comment on list.