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Recommendation on Stable IPv6 Interface Identifiers

Abstract

This document changes the recommended default Interface Identifier (IID) generation scheme for cases where Stateless Address Autoconfiguration (SLAAC) is used to generate a stable IPv6 address. It recommends using the mechanism specified in RFC 7217 in such cases, and recommends against embedding stable link-layer addresses in IPv6 IIDs. It formally updates RFC 2464, RFC 2467, RFC 2470, RFC 2491, RFC 2492, RFC 2497, RFC 2590, RFC 3146, RFC 3572, RFC 4291, RFC 4338, RFC 4391, RFC 5072, and RFC 5121. This document does not change any existing recommendations concerning the use of temporary addresses as specified in RFC 4941.

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 http://www.rfc-editor.org/info/rfc8064.

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1. Introduction

[RFC4862] specifies Stateless Address Autoconfiguration (SLAAC) for IPv6 [RFC2460], which typically results in hosts configuring one or more "stable" addresses composed of a network prefix advertised by a local router, and an Interface Identifier (IID) [RFC4291] that typically embeds a stable link-layer address (e.g., an IEEE LAN MAC address).

In some network technologies and adaptation layers, the use of an IID based on a link-layer address may offer some advantages. For example, [RFC6282] allows for the compression of IPv6 datagrams over IEEE 802.15.4-based networks [RFC4944] when the IID is based on the underlying link-layer address.

The security and privacy implications of embedding a stable link-layer address in an IPv6 IID have been known for some time now and are discussed in great detail in [RFC7721]. They include:

- Network-activity correlation
- Location tracking
- Address scanning
- Device-specific vulnerability exploitation

More generally, the reuse of identifiers that have their own semantics or properties across different contexts or scopes can be detrimental for security and privacy [NUM-IDS]. In the case of traditional stable IPv6 IIDs, some of the security and privacy implications are dependent on the properties of the underlying link-layer addresses (e.g., whether the link-layer address is ephemeral or randomly generated), while other implications (e.g., reduction of the entropy of the IID) depend on the algorithm for generating the IID itself. In standardized recommendations for stable IPv6 IID generation meant to achieve particular security and privacy properties, it is necessary to recommend against embedding stable link-layer addresses in IPv6 IIDs.

Furthermore, some popular IPv6 implementations have already deviated from the traditional stable IID generation scheme to mitigate the aforementioned security and privacy implications [Microsoft].

As a result of the aforementioned issues, this document changes the recommended default IID generation scheme for generating stable IPv6 addresses with SLAAC to that specified in [RFC7217] and recommends against embedding stable link-layer addresses in IPv6 Interface

Identifiers, such that the aforementioned issues are mitigated. That is, this document simply replaces the default algorithm that is recommended to be employed when generating stable IPv6 IIDs.

NOTE:
[RFC4291] defines the "Modified EUI-64 format" for IIDs. Appendix A of [RFC4291] then describes how to transform an IEEE EUI-64 identifier, or an IEEE 802 48-bit MAC address from which an EUI-64 identifier is derived, into an IID in the Modified EUI-64 format.

In a variety of scenarios, addresses that remain stable for the lifetime of a host's connection to a single subnet are viewed as desirable. For example, stable addresses may be viewed as beneficial for network management, event logging, enforcement of access control, provision of quality of service, or for server or router interfaces. Similarly, stable addresses (as opposed to temporary addresses [RFC4941]) allow for long-lived TCP connections and are also usually desirable when performing server-like functions (i.e., receiving incoming connections).

The recommendations in this document apply only in cases where implementations otherwise would have configured a stable IPv6 IID containing a link-layer address. For example, this document does not change any existing recommendations concerning the use of temporary addresses as specified in [RFC4941] and the recommendations do not apply to cases where SLAAC is employed to generate non-stable IPv6 addresses (e.g., by embedding a link-layer address that is periodically randomized); in addition, this document does not introduce any new requirements regarding when stable addresses are to be configured. Thus, the recommendations in this document simply improve the security and privacy properties of stable addresses.

2. Terminology

Stable address:
An address that does not vary over time within the same network (as defined in [RFC7721]).

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 RFC 2119 [RFC2119].

3. Generation of IPv6 Interface Identifiers with SLAAC

Nodes SHOULD implement and employ [RFC7217] as the default scheme for generating stable IPv6 addresses with SLAAC. A link layer MAY also define a mechanism for stable IPv6 address generation that is more efficient and does not address the security and privacy considerations discussed in Section 1. The choice of whether or not to enable the security- and privacy-preserving mechanism SHOULD be configurable in such a case.

By default, nodes SHOULD NOT employ IPv6 address generation schemes that embed a stable link-layer address in the IID. In particular, this document RECOMMENDS that nodes do not generate stable IIDs with the schemes specified in [RFC2464], [RFC2467], [RFC2470], [RFC2491], [RFC2492], [RFC2497], [RFC2590], [RFC3146], [RFC3572], [RFC4338], [RFC4391], [RFC5072], and [RFC5121].

4. Future Work

At the time of this writing, the mechanisms specified in the following documents might require updates to be fully compatible with the recommendations in this document:

- "Compression Format for IPv6 Datagrams over IEEE 802.15.4-Based Networks" [RFC6282]
- "Transmission of IPv6 Packets over IEEE 802.15.4 Networks" [RFC4944]
- "Neighbor Discovery Optimization for IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs)" [RFC6775]
- "Transmission of IPv6 Packets over ITU-T G.9959 Networks" [RFC7428]

Future revisions or updates of these documents should consider the issues of privacy and security mentioned in Section 1 and explain any design and engineering considerations that lead to the use of stable IIDs based on a node's link-layer address.

5. Security Considerations

This document recommends against the (default) use of predictable Interface Identifiers in IPv6 addresses. It recommends [RFC7217] as the default scheme for generating IPv6 stable addresses with SLAAC, such that the security and privacy issues of IIDs that embed stable link-layer addresses are mitigated.

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