

IPv6 maintenance Working Group (6man)
Internet-Draft
Updates: [2464](#), [2467](#), [2470](#), 2491, 2492,
[2497](#), [2590](#), [3146](#), [3572](#), [4291](#),
4338, 4391, 4944, 5072, 5121
(if approved)

Intended status: Standards Track

Expires: November 7, 2015

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May 6, 2015

Recommendation on Stable IPv6 Interface Identifiers
draft-ietf-6man-default-iids-03

Abstract

The IPv6 addressing architecture defines Modified EUI-64 format Interface Identifiers, and the existing IPv6 over various link-layers specify how such identifiers are derived from the underlying link-layer address (e.g., an IEEE LAN MAC address) when employing IPv6 Stateless Address Autoconfiguration (SLAAC). The security and privacy implications of embedding link-layer addresses in the Interface Identifier have been known and understood for some time now, and some popular IPv6 implementations have already deviated from such schemes to mitigate these issues. This document changes the recommended default Interface Identifier generation scheme for SLAAC to that specified in [RFC7217](#), and recommends against embedding link-layer addresses in IPv6 Interface Identifiers. It formally updates [RFC2464](#), [RFC2467](#), [RFC2470](#), [RFC2491](#), [RFC2492](#), [RFC2497](#), [RFC2590](#), [RFC3146](#), [RFC3572](#), [RFC4291](#), [RFC4338](#), [RFC4391](#), [RFC4944](#), [RFC5072](#), and [RFC5121](#), which require IPv6 Interface Identifiers to be derived from the underlying link-layer address. Additionally, this document provides advice about the generation of Interface Identifiers with other address configuration mechanisms, such as Dynamic Host Configuration Protocol version 6 (DHCPv6) and manual configuration.

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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 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, the IP-over-IEEE802.15.4 standard in [\[RFC6775\]](#) allows for compression of IPv6 addresses when the IID is based on the underlying link-layer address.

The security and privacy implications of embedding a link-layer address in an IPv6 IID have been known for some time now, and are discussed in great detail in [\[I-D.ietf-6man-ipv6-address-generation-privacy\]](#); they include:

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

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 recommends the implementation of an alternative scheme ([\[RFC7217\]](#)) as the default stable IID generation scheme for SLAAC, such that the aforementioned issues are mitigated.

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.

Finally this document provides advice about the generation of Interface Identifiers with other address configuration mechanisms, such as Dynamic Host Configuration Protocol version 6 (DHCPv6) and manual configuration.

2. Terminology

Stable address:

An address that does not vary over time within the same network (as defined in [\[I-D.ietf-6man-ipv6-address-generation-privacy\]](#)).

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

Link layers MUST define a mechanism that provides mitigation of the security and privacy implications discussed in [Section 1](#). 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 that is more efficient and does not address the security and privacy considerations discussed in [Section 1](#). The choice of whether to enable privacy or not SHOULD be configurable in such a case.

By default, nodes SHOULD NOT employ IPv6 address generation schemes that embed the underlying link-layer address in the IID. In particular, this document RECOMMENDS that nodes do not generate IIDs with the schemes specified in [\[RFC2464\]](#), [\[RFC2467\]](#), [\[RFC2470\]](#), [\[RFC2491\]](#), [\[RFC2492\]](#), [\[RFC2497\]](#), [\[RFC2590\]](#), [\[RFC3146\]](#), [\[RFC3572\]](#), [\[RFC4338\]](#), [\[RFC4391\]](#), [\[RFC4944\]](#), [\[RFC5121\]](#), and [\[RFC5072\]](#), and updates these documents with this recommendation.

It is RECOMMENDED by this document that future specifications do not specify IPv6 address generation schemes that embed the underlying link-layer address in the IID. Future specifications MAY use an IID based on a node's link-layer address if design and engineering considerations warrant.

4. Generation of IPv6 Interface Identifiers with DHCPv6

By default, DHCPv6 server implementations SHOULD NOT generate predictable IPv6 addresses (such as IPv6 addresses where the IIDs are consecutive small numbers). [\[I-D.ietf-dhc-stable-privacy-addresses\]](#) specifies one possible algorithm that could be employed to comply with this requirement. Another possible algorithm would be to select a pseudo-random value chosen from a discrete uniform distribution, while avoiding the reserved IPv6 Interface Identifiers [\[RFC5453\]](#) [\[IANA-RESERVED-IID\]](#).

5. Generation of IPv6 Interface Identifiers with Manual Configuration

Network administrators should be aware of the security implications of predictable Interface Identifiers [\[I-D.ietf-6man-ipv6-address-generation-privacy\]](#), and avoid the use of predictable addresses when the aforementioned issues are of concern.

6. 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:

- o [RFC 6282](#) [[RFC6282](#)]
- o [RFC 4944](#) [[RFC4944](#)]
- o [RFC 6755](#) [[RFC6775](#)]

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

[7.](#) IANA Considerations

There are no IANA registries within this document. The RFC-Editor can remove this section before publication of this document as an RFC.

[8.](#) Security Considerations

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

[9.](#) Acknowledgements

The authors would like to thank Erik Nordmark and Ray Hunter for providing a detailed review of this document.

The authors would like to thank (in alphabetical order) Fred Baker, Carsten Bormann, Scott Brim, Brian Carpenter, Samita Chakrabarti, Tim Chown, Lorenzo Colitti, Jean-Michel Combes, Greg Daley, Esko Dijk, Ralph Droms, David Farmer, Brian Haberman, Ulrich Herberg, Bob Hinden, Jahangir Hossain, Jonathan Hui, Ray Hunter, Sheng Jiang, Roger Jorgensen, Dan Luedtke, Kerry Lynn, George Mitchel, Erik Nordmark, Simon Perreault, Tom Petch, Alexandru Petrescu, Michael Richardson, Arturo Servin, Mark Smith, Tom Taylor, Ole Troan, Tina Tsou, Glen Turner, Randy Turner, and James Woodyatt, for providing valuable comments on earlier versions of this document.

[10.](#) References

[10.1.](#) Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.

- [RFC2460] Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", [RFC 2460](#), December 1998.
- [RFC2464] Crawford, M., "Transmission of IPv6 Packets over Ethernet Networks", [RFC 2464](#), December 1998.
- [RFC2467] Crawford, M., "Transmission of IPv6 Packets over FDDI Networks", [RFC 2467](#), December 1998.
- [RFC2470] Crawford, M., Narten, T., and S. Thomas, "Transmission of IPv6 Packets over Token Ring Networks", [RFC 2470](#), December 1998.
- [RFC2492] Armitage, G., Schultze, P., and M. Jork, "IPv6 over ATM Networks", [RFC 2492](#), January 1999.
- [RFC3315] Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C., and M. Carney, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)", [RFC 3315](#), July 2003.
- [RFC4291] Hinden, R. and S. Deering, "IP Version 6 Addressing Architecture", [RFC 4291](#), February 2006.
- [RFC4862] Thomson, S., Narten, T., and T. Jinmei, "IPv6 Stateless Address Autoconfiguration", [RFC 4862](#), September 2007.
- [RFC7217] Gont, F., "A Method for Generating Semantically Opaque Interface Identifiers with IPv6 Stateless Address Autoconfiguration (SLAAC)", [RFC 7217](#), April 2014.
- [RFC2491] Armitage, G., Schultze, P., Jork, M., and G. Harter, "IPv6 over Non-Broadcast Multiple Access (NBMA) networks", [RFC 2491](#), January 1999.
- [RFC2497] Souvatzis, I., "Transmission of IPv6 Packets over ARCnet Networks", [RFC 2497](#), January 1999.
- [RFC2590] Conta, A., Malis, A., and M. Mueller, "Transmission of IPv6 Packets over Frame Relay Networks Specification", [RFC 2590](#), May 1999.
- [RFC3146] Fujisawa, K. and A. Onoe, "Transmission of IPv6 Packets over IEEE 1394 Networks", [RFC 3146](#), October 2001.
- [RFC3572] Ogura, T., Maruyama, M., and T. Yoshida, "Internet Protocol Version 6 over MAPOS (Multiple Access Protocol Over SONET/SDH)", [RFC 3572](#), July 2003.

- [RFC4338] DeSanti, C., Carlson, C., and R. Nixon, "Transmission of IPv6, IPv4, and Address Resolution Protocol (ARP) Packets over Fibre Channel", [RFC 4338](#), January 2006.
- [RFC4391] Chu, J. and V. Kashyap, "Transmission of IP over InfiniBand (IPoIB)", [RFC 4391](#), April 2006.
- [RFC4944] Montenegro, G., Kushalnagar, N., Hui, J., and D. Culler, "Transmission of IPv6 Packets over IEEE 802.15.4 Networks", [RFC 4944](#), September 2007.
- [RFC5121] Patil, B., Xia, F., Sarikaya, B., Choi, JH., and S. Madanapalli, "Transmission of IPv6 via the IPv6 Convergence Sublayer over IEEE 802.16 Networks", [RFC 5121](#), February 2008.
- [RFC5072] Varada, S., Haskins, D., and E. Allen, "IP Version 6 over PPP", [RFC 5072](#), September 2007.
- [RFC5453] Krishnan, S., "Reserved IPv6 Interface Identifiers", [RFC 5453](#), February 2009.
- [RFC6282] Hui, J. and P. Thubert, "Compression Format for IPv6 Datagrams over IEEE 802.15.4-Based Networks", [RFC 6282](#), September 2011.
- [RFC6775] Shelby, Z., Chakrabarti, S., Nordmark, E., and C. Bormann, "Neighbor Discovery Optimization for IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs)", [RFC 6775](#), November 2012.

[10.2.](#) Informative References

- [IANA-RESERVED-IID]
IANA, "Reserved IPv6 Interface Identifiers",
<<http://www.iana.org/assignments/ipv6-interface-ids>>.
- [I-D.ietf-6man-ipv6-address-generation-privacy]
Cooper, A., Gont, F., and D. Thaler, "Privacy Considerations for IPv6 Address Generation Mechanisms",
[draft-ietf-6man-ipv6-address-generation-privacy-05](#) (work in progress), April 2015.

[I-D.ietf-dhc-stable-privacy-addresses]

Gont, F. and W. Will, "A Method for Generating Semantically Opaque Interface Identifiers with Dynamic Host Configuration Protocol for IPv6 (DHCPv6)", [draft-ietf-dhc-stable-privacy-addresses-02](#) (work in progress), April 2015.

[Microsoft]

Davies, J., "Understanding IPv6, 3rd. ed", page 83, Microsoft Press, 2012, <<http://it-ebooks.info/book/1022/>>.

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