

SAVI
Internet-Draft
Intended status: Standards Track
Expires: July 5, 2017

J. Bi
Tsinghua University
G. Yao
Tsinghua University/Baidu
J. Halpern
Ericsson
E. Levy-Abegnoli, Ed.
Cisco
January 1, 2017

**SAVI for Mixed Address Assignment Methods Scenario
draft-ietf-savi-mix-15**

Abstract

In networks that use multiple techniques for address assignment, the spoofing of addresses assigned by each technique can be prevented using the appropriate Source Address Validation Improvement (SAVI) methods. This document reviews how multiple SAVI methods can coexist in a single SAVI device and collisions are resolved when the same binding entry is discovered by two or more methods.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of [BCP 78](#) and [BCP 79](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <http://datatracker.ietf.org/drafts/current/>.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on July 5, 2017.

Copyright Notice

Copyright (c) 2017 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](#) and the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>) in effect on the date of

publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Table of Contents

- [1.](#) Introduction [2](#)
- [2.](#) Requirements Language [3](#)
- [3.](#) Problem Scope [3](#)
- [4.](#) Architecture [4](#)
- [5.](#) Recommendations for assignment separation [5](#)
- [6.](#) Resolving binding collisions [6](#)
 - [6.1.](#) Same Address on Different Binding Anchors [6](#)
 - [6.1.1.](#) Basic preference [6](#)
 - [6.1.2.](#) Exceptions [7](#)
 - [6.1.3.](#) Multiple SAVI Device Scenario [8](#)
 - [6.2.](#) Same Address on the Same Binding Anchor [8](#)
- [7.](#) Security Considerations [9](#)
- [8.](#) Privacy Considerations [9](#)
- [9.](#) IANA Considerations [9](#)
- [10.](#) Acknowledgment [9](#)
- [11.](#) References [9](#)
 - [11.1.](#) Normative References [9](#)
 - [11.2.](#) Informative References [10](#)
- Authors' Addresses [10](#)

1. Introduction

There are currently several Source Address Validation Improvement (SAVI) documents ([[RFC6620](#)], [[RFC7513](#)] and [[RFC7219](#)]) that describe the different methods by which a switch can discover and record bindings between a node's IP address and a binding anchor and use that binding to perform source address validation. Each of these documents specifies how to learn on-link addresses, based on the technique used for their assignment, respectively: Stateless Autoconfiguration (SLAAC), Dynamic Host Control Protocol (DHCP) and Secure Neighbor Discovery (SeND). Each of these documents describes separately how one particular SAVI method deals with address collisions (same address, different binding anchor).

While multiple IP assignment techniques can be used in the same layer-2 domain, this means that a single SAVI device might have to deal with a combination or mix of SAVI methods. The purpose of this document is to provide recommendations to avoid collisions and to

review collisions handling when two or more such methods come up with competing bindings.

2. Requirements Language

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. Problem Scope

Three different IP address assignment techniques have been analyzed for SAVI:

1. Stateless Address AutoConfiguration (SLAAC) - analyzed in SAVI-FCFS[[RFC6620](#)]
2. Dynamic Host Control Protocol address assignment (DHCP) - analyzed in SAVI-DHCP[[RFC7513](#)]
3. Secure Neighbor Discovery (SeND) address assignment, analyzed in SAVI-SEND[[RFC7219](#)]

In addition, there is a fourth technique for managing (i.e., creation, management, deletion) a binding on the switch, referred to as "manual". It is based on manual binding configuration. Because how to manage manual bindings is determined by operators, there is not a new SAVI method for manual addresses.

All combinations of address assignment techniques can coexist within a layer-2 domain. A SAVI device MUST implement the corresponding binding setup methods (referred to as a "SAVI method") for each such technique that is in use if it is to provide Source Address Validation.

SAVI methods are normally viewed as independent from each other, each one handling its own entries. If multiple methods are used in the same device without coordination, each method will attempt to reject packets sourced with any addresses that method did not discover. To prevent addresses discovered by one SAVI method from being filtered out by another method, the SAVI binding table SHOULD be shared by all the SAVI methods in use in the device. This in turn could create some conflict when the same entry is discovered by two different methods. The purpose of this document is of two folds: provide recommendations and methods to avoid conflicts, and to resolve conflicts when they happen. Collisions happening within a given method are outside the scope of this document.

4. Architecture

A SAVI device may implement and use multiple SAVI methods. This mechanism, called SAVI-MIX, is proposed as an arbiter of the binding generation algorithms from these multiple methods, generating the final binding entries as illustrated in Figure 1. Once a SAVI method generates a candidate binding, it will request SAVI-MIX to set up a corresponding entry in the binding table. Then SAVI-MIX will check if there is any conflict in the binding table. A new binding will be generated if there is no conflict. If there is a conflict, SAVI-MIX will determine whether to replace the existing binding or reject the candidate binding based on the policies specified in [Section 6](#).

As a result of this, the packet filtering in the SAVI device will not be performed by each SAVI method separately. Instead, the table resulting from applying SAVI-MIX will be used to perform filtering. Thus the filtering is based on the combined results of the different SAVI mechanisms. It is beyond the scope of this document to describe the details of the filtering mechanism and its use of the combined SAVI binding table.

address space across address assignment techniques, and thus across SAVI methods is therefore recommended. To that end, one should:

1. DHCP and SLAAC: use non-overlapping prefix for DHCP and SLAAC. Set the A bit in Prefix information option of Router Advertisement for SLAAC prefix, and set the M bit in Router Advertisement for DHCP prefix. For detail explanations on these bits, refer to [[RFC4861](#)][RFC4862].
2. SeND and non-SeND: avoid mixed environment (where SeND and non-SeND nodes are deployed) or separate the prefixes announced to SeND and non-SeND nodes. One way to separate the prefixes is to have the router(s) announcing different (non-overlapping) prefixes to SeND and to non-SeND nodes, using unicast Router Advertisements[RFC6085], in response to SeND/non-SeND Router Solicit.

6. Resolving binding collisions

In situations where collisions can not be avoided by assignment separation, two cases should be considered:

1. The same address is bound on two different binding anchors by different SAVI methods.
2. The same address is bound on the same binding anchor by different SAVI methods.

6.1. Same Address on Different Binding Anchors

This would typically occur in case assignment address spaces could not be separated. For instance, an address is assigned by SLAAC on node X, installed in the binding table using SAVI-FCFS, anchored to "anchor-X". Later, the same address is assigned by DHCP to node Y, and SAVI-DHCP will generate a candidate binding entry, anchored to "anchor-Y".

6.1.1. Basic preference

If there is any manually configured binding, the SAVI device SHOULD choose the manual configured binding anchor.

For an address not covered by any manual bindings, the SAVI device must decide to which binding anchor the address should be bound (anchor-X or anchor-Y in this example). Current standard documents of address assignment methods have implied the prioritization relationship based on order in time, i.e., first-come first-served.

- o SLAAC: s5.4.5 of [[RFC4862](#)]
- o DHCPv4: s3.1-p5 of [[RFC2131](#)]
- o DHCPv6: s18.1.8 of [[RFC3315](#)]
- o SeND: s8 of [[RFC3971](#)]

In the absence of any configuration or protocol hint (see [Section 6.1.2](#)) the SAVI device SHOULD choose the first-come binding anchor, whether it was learnt from SLAAC, SeND or DHCP.

[6.1.2](#). Exceptions

There are two identified exceptions to the general prioritization model, one of them being CGA addresses[[RFC3971](#)], another one controlled by the configuration of the switch.

[6.1.2.1](#). CGA preference

When CGA addresses are used, and a collision is detected, preference should be given to the anchor that carries the CGA credentials once they are verified, in particular the CGA parameters and the RSA options. Note that if an attacker was trying to replay CGA credentials, he would then compete on the base of "First-Come, First-Served" (FCFS) principle.

[6.1.2.2](#). configuration preference

For configuration driven exceptions, the SAVI device may allow the configuration of a triplet ("prefix", "anchor", "method") or ("address", "anchor", "method"). The "prefix" or "address" represents the address or address prefix to which this preference entry applies. The "anchor" is the value of a known binding anchor that this device expects to see using this address or addresses from this prefix. The "method" is the SAVI method that this device expects to use in validating address binding entries from the address or prefix. At least one of "anchor" and "method" MUST be specified. Later, if a DAD message [[RFC4861](#)] is received with the following conditions verified:

1. The target in the DAD message does not exist in the binding table
2. The target is within the configured "prefix" (or equal to "address")
3. The anchor bound to target is different from the configured anchor, when specified

4. The configured method, if any, is different from SAVI-FCFS

The switch SHOULD defend the address by responding to the DAD message, with a NA message, on behalf of the target node. It SHOULD NOT install the entry into the binding table. The DAD message SHOULD be discarded and not forwarded. Forwarding it may cause other SAVI devices to send additional defense NAs. SEND nodes in the network MUST disable the option to ignore unsecured advertisements (see s8 of [\[RFC3971\]](#)). If the option is enabled, the case is outside the scope of this document. It is suggested to limit the rate of defense NAs to reduce security threats to the switch. Or else, a malicious host could consume the resource of the switch heavily with flooding DAD messages.

This will simply prevent the node from assigning the address, and will de-facto prioritize the configured anchor. It is especially useful to protect well known bindings such as a static address of a server over anybody, even when the server is down. It is also a way to give priority to a binding learnt from SAVI-DHCP over a binding for the same address, learnt from SAVI-FCFS.

6.1.3. Multiple SAVI Device Scenario

A single SAVI device doesn't have the information of all bound addresses on the perimeter. Therefore it is not enough to lookup local bindings to identify a collision. However, assuming DAD is performed throughout the security perimeter for all addresses regardless of the assignment method, then DAD response will inform all SAVI devices about any collision. In that case, "First-Come, First-Served" will apply the same way as in a single switch scenario. If the admin configured on one the switches a prefix (or a single static binding) to defend, the DAD response generated by this switch will also prevent the binding to be installed on other switches of the perimeter. The SAVI MIX preferences of all the SAVI devices in the same layer-2 domain should be consistent. Inconsistent configurations may cause network breaks.

6.2. Same Address on the Same Binding Anchor

A binding may be set up on the same binding anchor by multiple methods, typically SAVI-FCFS and SAVI-DHCP. If the binding lifetimes obtained from the two methods are different, priority should be given to 1) Manual configuration 2) SAVI-DHCP 3) SAVI-FCFS as the least authoritative. The binding will be removed when the prioritized lifetime expires, even if a less authoritative method had a longer lifetime.

7. Security Considerations

Combining SAVI methods (as in SAVI MIX) does not improve on or eliminate the security considerations associated with each individual SAVI method. Therefore, security considerations for each enabled SAVI method should be addressed as described in that method's associated RFC. Moreover, combining methods (as in SAVI MIX) has two additional implications for security. First, it may increase susceptibility to DoS attacks, because the SAVI binding setup rate will be the sum of the rates of all enabled SAVI methods. Implementers must take these added resource requirements into account. Second, because SAVI MIX supports multiple binding mechanisms, it potentially reduces the security level to that of the weakest supported method, unless additional steps (e.g. requiring non-overlapping address spaces for different methods) are taken.

8. Privacy Considerations

When implementing multiple SAVI methods, privacy considerations of all methods apply cumulatively.

9. IANA Considerations

This memo asks the IANA for no new parameters.

10. Acknowledgment

Thanks to Christian Vogt, Eric Nordmark, Marcelo Bagnulo Braun, David Lamparter, Scott G. Kelly and Jari Arkko for their valuable contributions.

11. References

11.1. 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, <<http://www.rfc-editor.org/info/rfc2119>>.
- [RFC2131] Droms, R., "Dynamic Host Configuration Protocol", [RFC 2131](#), DOI 10.17487/RFC2131, March 1997, <<http://www.rfc-editor.org/info/rfc2131>>.
- [RFC3315] Droms, R., Ed., Bound, J., Volz, B., Lemon, T., Perkins, C., and M. Carney, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)", [RFC 3315](#), DOI 10.17487/RFC3315, July 2003, <<http://www.rfc-editor.org/info/rfc3315>>.

- [RFC3971] Arkko, J., Ed., Kempf, J., Zill, B., and P. Nikander, "SEcure Neighbor Discovery (SEND)", [RFC 3971](#), DOI 10.17487/RFC3971, March 2005, <<http://www.rfc-editor.org/info/rfc3971>>.
- [RFC6085] Gundavelli, S., Townsley, M., Troan, O., and W. Dec, "Address Mapping of IPv6 Multicast Packets on Ethernet", [RFC 6085](#), DOI 10.17487/RFC6085, January 2011, <<http://www.rfc-editor.org/info/rfc6085>>.
- [RFC6620] Nordmark, E., Bagnulo, M., and E. Levy-Abegnoli, "FCFS SAVI: First-Come, First-Served Source Address Validation Improvement for Locally Assigned IPv6 Addresses", [RFC 6620](#), DOI 10.17487/RFC6620, May 2012, <<http://www.rfc-editor.org/info/rfc6620>>.
- [RFC7219] Bagnulo, M. and A. Garcia-Martinez, "SEcure Neighbor Discovery (SEND) Source Address Validation Improvement (SAVI)", [RFC 7219](#), DOI 10.17487/RFC7219, May 2014, <<http://www.rfc-editor.org/info/rfc7219>>.
- [RFC7513] Bi, J., Wu, J., Yao, G., and F. Baker, "Source Address Validation Improvement (SAVI) Solution for DHCP", [RFC 7513](#), DOI 10.17487/RFC7513, May 2015, <<http://www.rfc-editor.org/info/rfc7513>>.

11.2. Informative References

- [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, <<http://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, <<http://www.rfc-editor.org/info/rfc4862>>.
- [RFC7039] Wu, J., Bi, J., Bagnulo, M., Baker, F., and C. Vogt, Ed., "Source Address Validation Improvement (SAVI) Framework", [RFC 7039](#), DOI 10.17487/RFC7039, October 2013, <<http://www.rfc-editor.org/info/rfc7039>>.

Authors' Addresses

Jun Bi
Tsinghua University
Network Research Center, Tsinghua University
Beijing 100084
China

EEmail: junbi@tsinghua.edu.cn

Guang Yao
Tsinghua University/Baidu
Baidu Science and Technology Park, Building 1
Beijing 100193
China

EEmail: yaoguang.china@gmail.com

Joel M. Halpern
Ericsson

EEmail: joel.halpern@ericsson.com

Eric Levy-Abegnoli (editor)
Cisco Systems
Village d'Entreprises Green Side - 400, Avenue Roumanille
Biot-Sophia Antipolis 06410
France

EEmail: elevyabe@cisco.com

