Stream: Internet Engineering Task Force (IETF)
RFC: 9927
Updates: 8928
Category: Standards Track
Published: January 2026
ISSN: 2070-1721
Authors: P. Thubert A. Rashid
Politecnico di Bari

RFC 9927
Fixing the C-Flag in the Extended Address Registration Option (EARO)

Abstract

This document updates "Address-Protected Neighbor Discovery for Low-Power and Lossy Networks" (RFC 8928) by changing the position of the C-flag in the Extended Address Registration Option (EARO) and registering it with IANA.

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 https://www.rfc-editor.org/info/rfc9927.

Table of Contents

1. Introduction

The Address-Protected Neighbor Discovery for Low-Power and Lossy Networks (AP-ND) [RFC8928] defined the C-flag in EARO. It is used to indicate that the Registration Ownership Verifier (ROVR) field contains a Crypto-ID and that the 6LoWPAN Node (6LN) may be challenged for ownership of the registered address. Initially, [RFC8928] defined the C-flag in the EARO in bit position 3; later, [RFC9685] defined the P-Field in bits 2 and 3 of the EARO flags field with proper IANA registration, causing an overlap with Figure 1 of [RFC8928], which depicts the location of the C-flag.

This specification updates [RFC8928] by repositioning the C-flag as bit 1 of the EARO flags field, thereby preventing conflicts.

2. Terminology

2.1. Requirements Language

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.

2.2. Related Documents

This document uses terms and concepts that are discussed in IPv6 Neighbor Discovery (ND) [RFC4861], [RFC4862], as well as 6LoWPAN-ND [RFC6775], [RFC8505], [RFC8928], [RFC8929], [RFC9685], and [RFC9926].

2.3. Acronyms

This document uses the following abbreviations:

6LN: 6LoWPAN Node

EARO: Extended Address Registration Option

ND: Neighbor Discovery

RATInd: Registered Address Type Indicator

ROVR: Registration Ownership Verifier

3. Updating RFC 8928

[RFC8928] incorrectly refers to the Extended Address Registration Option (EARO) as the Enhanced Address Registration Option. This specification corrects this terminology throughout the document.

In [RFC8928], the C-flag is specified in the EARO flags field at bit position 3 (as depicted in Figure 1 of [RFC8928]); however, [RFC8928] fails to register its position with IANA. Later, [RFC9685] defined the P-Field in bits 2 and 3 of the EARO flags field and obtained proper IANA registration, but this introduced an overlap with the representation in [RFC8928]. To resolve the conflict, this specification updates [RFC8928] by repositioning the C-flag to bit 1 of the EARO flags field, ensuring there are no overlapping definitions.

Figure 1 replaces Figure 1 in [RFC8928] in the case of an EARO used in an NS message.

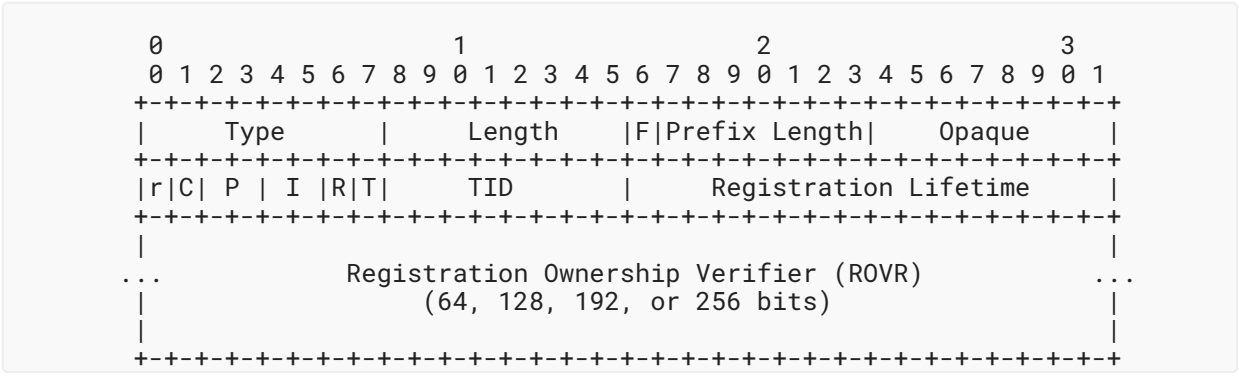

Figure 1: Extended Address Registration Option (EARO) Format for Use in NS Messages

Figure 2 replaces Figure 1 in [RFC8928] in the case of an EARO used in an NA message. The difference between the two formats is in the usage of bits 16 to 23.

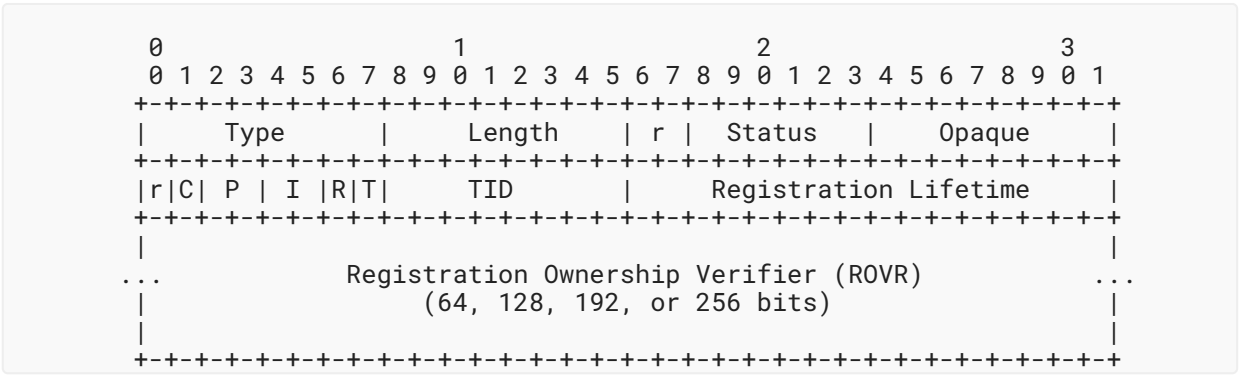

Figure 2: Extended Address Registration Option (EARO) Format for Use in NA Messages

Option fields of interest for this specification:

Type: 33

Length: Defined in [RFC8505]

F: Defined in [RFC9926]

Prefix Length Defined in [RFC9926]

Status: 6-bit unsigned integer. This field is used in NA(EARO) response messages only to indicate the status of a registration. This field is defined in [RFC8505] and resized by [RFC9010]. The values for the Status field are available in [IANA.ICMP.ARO.STAT]. This field **MUST** be set to 0 in NS(EARO) messages unless the registration is for a prefix, in which case the F-flag is set and the prefix length is provided.

Opaque: Defined in [RFC8505]

r (reserved): 1-bit reserved field in NS(EARO) and NA(EARO) as depicted in Figure 1 and Figure 2. 2-bit reserved field (most significant bits of Status filed) in NA(EARO) as depicted in Figure 2. All reserved field **MUST** be set to zero by the sender and **MUST** be ignored by the receiver.

C: 1-bit flag, moved from its position in Figure 1 of [RFC8928]. It is set to indicate that the ROVR field contains a Crypto-ID and that the 6LN **MAY** be challenged for ownership.

P: 2-bit field for Registered Address Type Indicator (RATInd). Indicates whether the registered address is unicast, multicast, anycast, or derived from the registered unicast prefix. Used to transport the RATInd in different protocols. The values for the RATInd field are available in [IANA.ICMP.ARO.P-FIELD].

I: Defined in [RFC8505]

R: Defined in [RFC8505]

T: Defined in [RFC8505]

TID (Transaction ID): Defined in [RFC8505]

Registration Lifetime: Defined in [RFC8505]

Registration Ownership Verifier (ROVR): Defined in [RFC8505]. Variable-length field used to verify who "owns" a registered IPv6 address. When the C-flag is set, this field contains a Crypto-ID [RFC8928].

4. Security Considerations

This specification does not introduce any new security considerations beyond those already discussed in [RFC8928] and [RFC8505].

5. Operational Considerations

The updates introduced in this document are not backward compatible. However, given that there are no known implementations or deployments of [RFC8928], this document does not require any transition plan.

6. IANA Considerations

6.1. Bit Position of the C-flag

IANA has updated the "Address Registration Option Flags" [IANA.ICMP.ARO.FLG] registry in the "Internet Control Message Protocol version 6 (ICMPv6) Parameters" registry group as specified in Table 1 so this document is referenced in addition to [RFC8928] for bit number 1:

Bit Number	Description	Reference
1	C-Flag	RFC 9927 and [RFC8928]

Table 1: Bit Position of the C-flag

7. References

7.1. Normative References

[IANA.ICMP.ARO.FLG] IANA, "Address Registration Option Flags", <https://www.iana.org/assignments/icmpv6-parameters>.

[IANA.ICMP.ARO.P-FIELD] IANA, "P-Field Values", <https://www.iana.org/assignments/icmpv6-parameters>.

[IANA.ICMP.ARO.STAT] IANA, "Address Registration Option Status Values", <https://www.iana.org/assignments/icmpv6-parameters>.

[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>.

[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>.

[RFC6775] Shelby, Z., Ed., Chakrabarti, S., Nordmark, E., and C. Bormann, "Neighbor Discovery Optimization for IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs)", RFC 6775, DOI 10.17487/RFC6775, November 2012, <https://www.rfc-editor.org/info/rfc6775>.

[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>.

[RFC8505] Thubert, P., Ed., Nordmark, E., Chakrabarti, S., and C. Perkins, "Registration Extensions for IPv6 over Low-Power Wireless Personal Area Network (6LoWPAN) Neighbor Discovery", RFC 8505, DOI 10.17487/RFC8505, November 2018, <https://www.rfc-editor.org/info/rfc8505>.

[RFC8928] Thubert, P., Ed., Sarikaya, B., Sethi, M., and R. Struik, "Address-Protected Neighbor Discovery for Low-Power and Lossy Networks", RFC 8928, DOI 10.17487/RFC8928, November 2020, <https://www.rfc-editor.org/info/rfc8928>.

[RFC9010] Thubert, P., Ed. and M. Richardson, "Routing for RPL (Routing Protocol for Low-Power and Lossy Networks) Leaves", RFC 9010, DOI 10.17487/RFC9010, April 2021, <https://www.rfc-editor.org/info/rfc9010>.

[RFC9685] Thubert, P., Ed., "Listener Subscription for IPv6 Neighbor Discovery Multicast and Anycast Addresses", RFC 9685, DOI 10.17487/RFC9685, November 2024, <https://www.rfc-editor.org/info/rfc9685>.

[RFC9926] Thubert, P., Ed., "IPv6 Neighbor Discovery Prefix Registration", RFC 9926, DOI 10.17487/RFC9926, January 2026, <https://www.rfc-editor.org/info/rfc9926>.

7.2. Informative References

[RFC8929] Thubert, P., Ed., Perkins, C.E., and E. Levy-Abegnoli, "IPv6 Backbone Router", RFC 8929, DOI 10.17487/RFC8929, November 2020, <https://www.rfc-editor.org/info/rfc8929>.

Authors' Addresses

Pascal Thubert
06330 Roquefort-les-Pins
France
Email: pascal.thubert@gmail.com

Adnan Rashid
Politecnico di Bari
Via Edoardo Orabona 4
70126 Bari
Italy
Email: adnan.rashid@poliba.it