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Registering Self-generated IPv6 Addresses using DHCPv6

Abstract

This document defines a method to inform a DHCPv6 server that a device has a self-generated or statically configured address.

About This Document

This note is to be removed before publishing as an RFC.

The latest revision of this draft can be found at https://wkumari.github.io/draft-wkumari-dhc-addr-notification/draft-wkumari-dhc-addr-notification.html. Status information for this document may be found at https://datatracker.ietf.org/doc/draft-wkumari-dhc-addr-notification/.

Discussion of this document takes place on the Dynamic Host Configuration Working Group mailing list (mailto:dhcwg@ietf.org), which is archived at https://mailarchive.ietf.org/arch/browse/dhcwg/. Subscribe at https://www.ietf.org/mailman/listinfo/dhcwg/.

Source for this draft and an issue tracker can be found at https://github.com/wkumari/draft-wkumari-dhc-addr-notification.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on 1 October 2023.

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1. Introduction

It is very common operational practice, especially in enterprise networks, to use IPv4 DHCP logs for troubleshooting or security purposes. Examples of this include a helpdesk dealing with a ticket such as "The CEO's laptop cannot connect to the printer"; if the MAC address of the printer is known (for example from an inventory system), the IPv4 address can be retrieved from the DHCP logs and the printer pinged to determine if it is reachable. Another common example is a Security Operations team discovering suspicious events in outbound firewall logs and then consulting DHCP logs to determine

which employee's laptop had that IPv4 address at that time so that they can quarantine it and remove the malware.

This operational practice relies on the DHCP server knowing the IP address assignments. Therefore, the practice does not work if static IP addresses are manually configured on devices or self-assigned addresses (such as when self-configuring an IPv6 address using SLAAC [RFC4862]) are used.

The lack of this parity with IPv4 is one of the reasons that some enterprise networks are unwilling to deploy IPv6.

This document provides a mechanism for a device to inform the DHCPv6 server that it has a self-configured IPv6 address (or has a statically configured address), and thus provides parity with IPv4 in this aspect.

2. Conventions and Definitions

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.

3. Description of Mechanism

After successfully assigning a self-generated IPv6 address on one of its interfaces, an end-host implementing this specification **SHOULD** multicast an ADDR-REG-INFORM message in order to inform the DHCPv6 server that this address is in use.

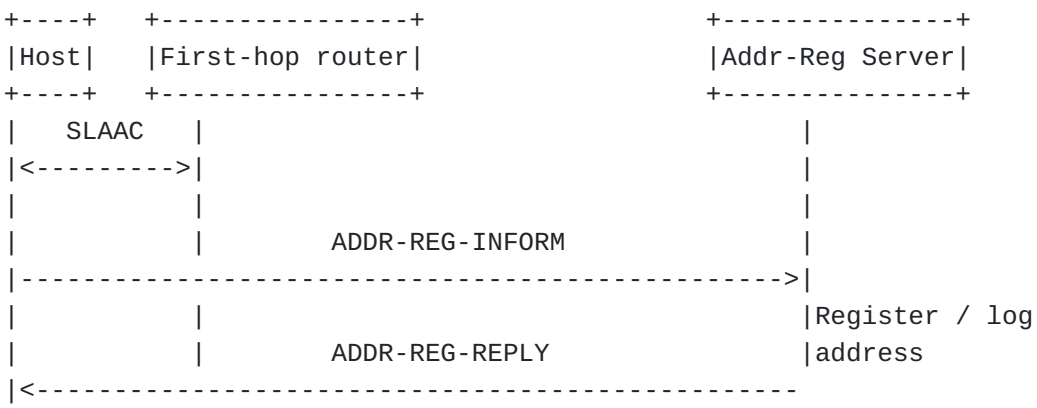
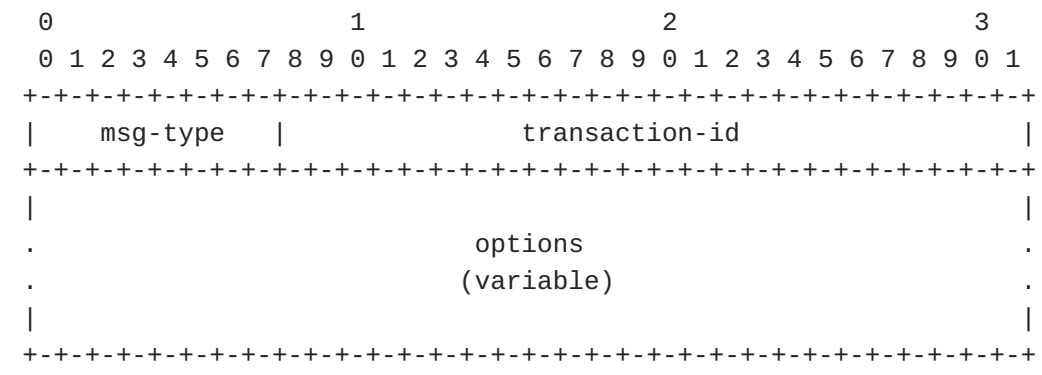


Figure 1: Address Registration Procedure

4. DHCPv6 ADDR-REG-INFORM Message

The DHCPv6 client sends an ADDR-REG-INFORM message to inform that an IPv6 address is in use. The format of the ADDR-REG-INFORM message is described as follows:



msg-type — Identifies the DHCPv6 message type; Set to ADDR-REG-INFORM (TBA1).

transaction-id — The transaction ID for this message exchange.

options — Options carried in this message.

Figure 2: DHCPv6 ADDR-REG-INFORM message

The ADDR-REG-INFORM message **MUST NOT** contain server-identifier option and **MUST** contain the IA Address option. The ADDR-REG-INFORM message is dedicated for clients to initiate an address registration request toward an address registration server. Consequently, clients **MUST NOT** put any Option Request Option(s) in the ADDR-REG-INFORM message. Clients **MAY** include other options, such as the Client FQDN Option [RFC4704].

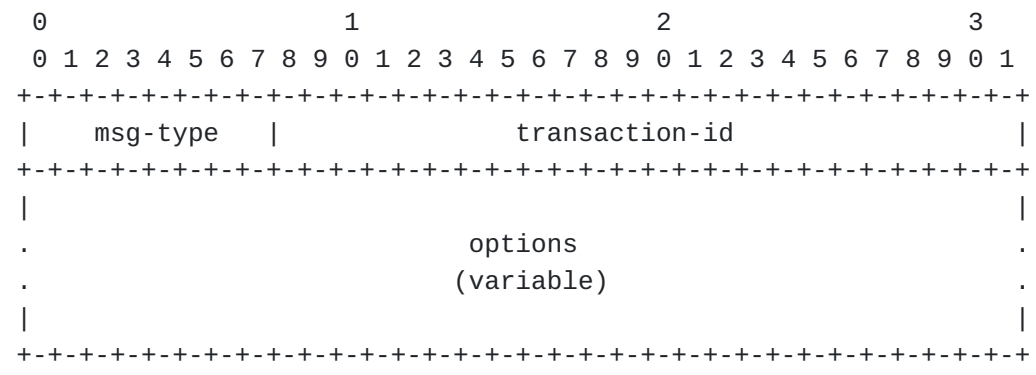
Clients **MUST** discard any received ADDR-REG-INFORM messages.

Servers **MUST** discard any ADDR-REG-INFORM messages that meet any of the following conditions:

- *the address is not appropriate for the link;
- *the message does not include a Client Identifier option;
- *the message includes a Server Identifier option;
- *the message does not include the IA Address option;
- *the message includes an Option Request Option.

5. DHCPv6 ADDR-REG-REPLY Message

The DHCPv6 server sends an ADDR-REG-REPLY message in response to a valid ADDR-REG-INFORM message. The format of the ADDR-REG-REPLY message is described as follows:



msg-type — Identifies the DHCPv6 message type; Set to ADDR-REG-REPLY (TBA2).

transaction-id — The transaction ID for this message exchange.

options — Options carried in this message.

Figure 3: DHCPv6 ADDR-REG-REPLY message

The ADDR-REG-INFORM message **MUST** contain an IA Address option for the address being registered.

Servers **MUST** ignore any received ADDR-REG-REPLY messages.

The IPv6 destination address of the packet is the address being registered.

6. DHCPv6 Address Registration Procedure

The DHCPv6 protocol is used as the address registration protocol when a DHCPv6 server performs the role of an address registration server. The DHCPv6 IA Address option [RFC8415] is adopted in order to fulfill the address registration interactions.

6.1. DHCPv6 Address Registration Request

The end-host sends a DHCPv6 ADDR-REG-INFORM message to the address registration server to the All_DHCP_Relay_Agents_and_Servers multicast address (ff02::1:2). The host **MUST** only send the packet on the network interface that has the address being registered (i.e. if the host has multiple interfaces with different addresses, it should only send the packet on the interface with the address being registered). The host **MUST** send the packet from the address being

registered. This is primarily for "fate sharing" purposes - for example, if the network implements some form of L2 security to prevent a client from spoofing other clients' addresses this prevents an attacker from spoofing ADDR-REG-INFORM messages. The host **MUST** send separate messages for each address being registered.

The end-host **MUST** include a Client Identifier option in the ADDR-REG-INFORM message.

The host **MUST** only send the ADDR-REG-INFORM message for valid ([RFC4862]) addresses of global scope ([RFC4007]). The host **MUST NOT** send the ADDR-REG-INFORM message for addresses configured by DHCPv6.

The host **MUST NOT** send the ADDR-REG-INFORM message if it has not received any Router Advertisement message with either M or O flags set to 1.

After receiving this ADDR-REG-INFORM message, the address registration server **SHOULD** verify that the address being registered is "appropriate to the link" as defined by [RFC8415]. If the server believes that address being registered is not appropriate to the link [RFC8415], it **MUST** drop the message, and **SHOULD** log this fact. If the address is appropriate, the server:

* **SHOULD** register or update a binding between the provided Client Identifier and IPv6 address in its database;

* **SHOULD** log the address registration information (as is done normally for clients which have requested an address), unless configured not to do so;

* **SHOULD** mark the address as unavailable for use and not include it in future ADVERTISE messages.

* **SHOULD** send back an ADDR-REG-REPLY message.

If the DHCPv6 server does not support the address registration function, it **MUST** drop the message, and **SHOULD** log this fact.

DHCPv6 relay agents and switches that relay address registration messages directly from clients **SHOULD** include the client's link-layer address in the relayed message using the Client Link-Layer Address option ([RFC6939])

6.2. DHCPv6 Address Registration Acknowledgement

The server **SHOULD** acknowledge receipt of an ADDR-REG-INFORM message by sending a ADDR-REG-REPLY message back. The ADDR-REG-REPLY message only indicates that the ADDR-REG-INFORM message has been received. It **MUST NOT** be considered as any indication of the address validity

and **MUST NOT** be required for the address to be usable. DHCPv6 relays, or other devices that snoop ADDR-REG-REPLY messages, **MUST NOT** add or alter any forwarding or security state based on the ADDR-REG-REPLY message.

6.3. Registration Expiry and Refresh

The client **MUST** refresh the registration every AddrRegRefresh seconds, where AddrRegRefresh is min(1/3 of the Valid Lifetime filed in the very first PIO received to form the address; 4 hours). Registration refresh packets **SHOULD** be retransmitted using the same logic as described in the 'Retransmission' section below. In particular, retransmissions **SHOULD** be jittered to avoid synchronization causing a large number of registrations to expire at the same time.

If the address registration server does not receive such a refresh after the preferred lifetime has passed, it **SHOULD** remove the record of the Client-Identifier-to-IPv6-address binding.

The client **MAY** choose to notify the server when an address is no longer being used (the client is disconnecting from the network, the address lifetime expired or the address is being removed from the interface). To indicate that the address is not being used anymore the client **MUST** set the preferred-lifetime and valid-lifetime fields of the IA Address option to zero.

6.4. Retransmission

To reduce the effects of packet loss on registration, the client **SHOULD** retransmit the registration message. Retransmissions **SHOULD** follow the standard retransmission logic specified by section 15 of [RFC8415] with the following default parameters:

*IRT 1 sec

*MRC 3

The client **SHOULD** allow these parameters to be configured by the administrator.

If an ADDR-REG-REPLY message is received for the address being registered, the client **MUST** stop retransmission. However, the client can not rely on the server acknowledging receipt of the registration message, because the server might not support address registration.

7. Host configuration

DHCP clients **SHOULD** allow the administrator to disable sending ADDR-REG-INFORM messages. This could be used, for example, to reduce

network traffic on networks where the servers are known not to support the message type. Sending the messages **SHOULD** be enabled by default.

8. Security Considerations

An attacker may attempt to register a large number of addresses in quick succession in order to overwhelm the address registration server and / or fill up log files. These attacks may be mitigated by using generic DHCPv6 protection such as the AUTH option [RFC8415]. The similar attack vector exist today, e.g. an attacker can DoS the server with messages contained spoofed DUIDs.

If a network is using FCFS SAVI [RFC6620], then the DHCPv6 server can trust that the ADDR-REG-INFORM message was sent by the legitimate owner of the address. This prevents a host from registering an address owned by another host.

One of the use-cases for the mechanism described in this document is to identify sources of malicious traffic after the fact. Note, however, that as the device itself is responsible for informing the DHCPv6 server that it is using an address, a malicious or compromised device can simply not send the ADDR-REG-INFORM message. This is an informational, optional mechanism, and is designed to aid in troubleshooting and forensics. On its own, it is not intended to be a strong security access mechanism.

9. IANA Considerations

This document defines a new DHCPv6 message, the ADDR-REG-INFORM message (TBA1) described in Section 4, that requires an allocation out of the registry of Message Types defined at http://www.iana.org/assignments/dhcpv6-parameters/

10. Normative References

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