IETF 120 – 6lo

Generic Address Assignment Option for 6LoWPAN Neighbor Discovery

~~draft-iannone-6lo-nd-gaao-02~~

draft-iannone-6lo-nd-gaao-03

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IETF 120 – Vancouver

Since IETF 119

Generic Address Assignment Option for 6LowPAN Neighbor Discovery

draft-iannone-6lo-nd-gaao-03

Status | Email expansions | History

Versions:

00 | 01 | 02 | 03

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draft-iannone-6lo-nd-gaao-03.txt
July 2024
Main changes: Revised message sequence and processing to improve clarity

General Changes

6lo Working Group L. Iannone
Internet-Draft D. Lou
Intended status: Standards Track Huawei
Expires: 2 September 2024 1 March 2024

Generic Address Assignment Option for 6LowPAN Neighbor Discovery
draft-iannone-6lo-nd-gaao-02

IPv6 Neighbor Discovery has been also adapted to the LLN environment in [RFC6775], later updated by [RFC8505], [RFC8929], and [RFC9010]. In particular, address assignment is relying on address auto-configuration [RFC4862], since the use of Dynamic Host Configuration Protocol (DHCP [RFC8415]) is not adapted to LLN deployments. Hence, mechanisms to register these self-generated addresses have been designed ([RFC6775], [I-D.thubert-6lo-prefix-registration], [RFC8505], [I-D.ietf-6lo-multicast-registration]).

Recent use cases show however, that there is some advantages in assigning addresses in an algorithmically managed way, which may simplify packet forwarding in some scenarios ([RFC9453], [I-D.ietf-6lo-path-aware-semantic-addressing], [SHENOY21], [BLESS22], [RIDOUX05]), hence reducing the power consumption and memory footprint. Algorithmic address assignment has its own pros and cons, as well as deployment requirements. However, they have the common benefit of being easily distributed. In other words, it is not necessary to have a centralized approach, like DHCP, rather a node can obtain an address generated from one of the neighbors by simply running the algorithm.

10.3. GAAO Error code

IANA is requested to make an addition to the "Address Registration Option Status Values" sub-registry under the heading "Internet Control Message Protocol version 6 (ICMPv6) Parameters" as indicated in Table 3:

Value	Description	Reference
6 (Suggested)	AAF Not Supported	[This Document]

Table 3: New address registration option value.

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Intended status: Standards Track Huawei
Expires: 9 January 2025 A. Rashid
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8 July 2024

Generic Address Assignment Option for 6LowPAN Neighbor Discovery
draft-iannone-6lo-nd-gaao-03

IPv6 Neighbor Discovery has been also adapted to the LLN environment in [RFC6775], later updated by [RFC8505], [RFC8929], and [RFC9010]. In particular, interface address assignment relies on address auto-configuration [RFC4862], since the use of Dynamic Host Configuration Protocol (DHCP [RFC8415]) is not adapted to LLN deployments. Hence, mechanisms to register these self-generated addresses have been designed ([RFC6775], [I-D.ietf-6lo-prefix-registration], [RFC8505], [I-D.ietf-6lo-multicast-registration]).

Recent use cases show, however, that there are some advantages in assigning addresses in an algorithmically managed way. In particular, in some scenarios, routing and forwarding can be simplified ([RFC9453], [I-D.ietf-6lo-path-aware-semantic-addressing], [SHENOY21], [BLESS22], [RIDOUX05]), hence reducing the power consumption and memory footprint. Algorithmic address assignment has its own pros and cons, as well as deployment requirements. However, they have the common benefit of being easily distributed. In other words, it is not necessary to have a centralized approach, like DHCP, rather a node can obtain an address generated by one of its neighbors who simply runs an algorithm.

10.3. GAAO Error code

IANA is requested to make an addition to the "Address Registration Option Status Values" registry under the registry group "Internet Control Message Protocol version 6 (ICMPv6) Parameters" as indicated in Table 3:

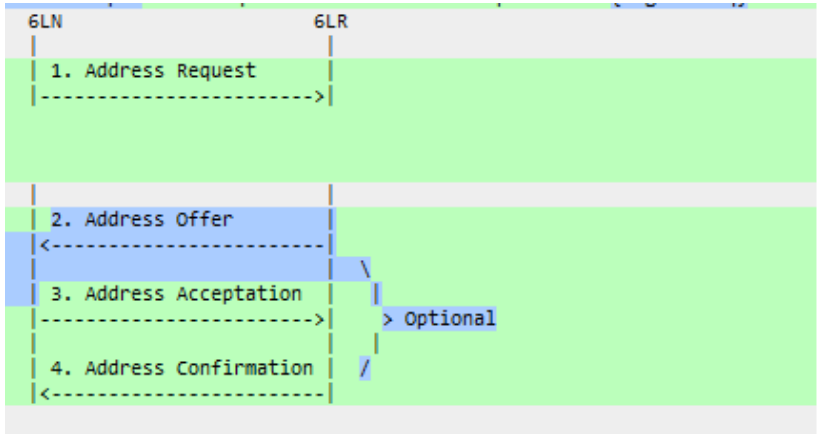
Value	Description	Reference
13 (Suggested)	AAF Not Supported	[This Document]

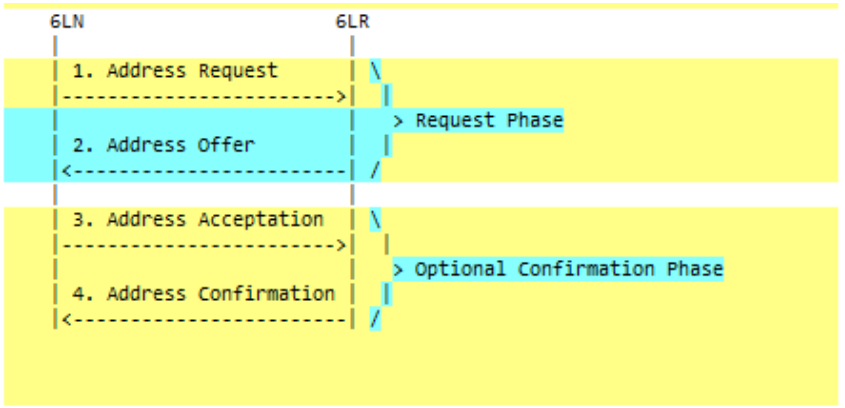
Table 3: New address registration option value.

- Welcome Adnan! ☺
- Removed (a lot) of typos
- Updated IANA section according to IANA review

Message Sequence & Processing text improvements

No technical changes just improved text





- Better clarify the two phases
- Created two subsections for each phase

Request Phase

1. The node will issue a NS message with the GAAO option to request an address assignment. This initial GAAO option has length equal to ROVR's length as multiple of 8 bytes plus one (no address appended), Status/PfxLength set to 0. Opaque, as well as the F-bit and I-bits will be set according to local configuration. The C-bit is set to zero. The P-bits are set according to the type of address it is requesting. The AAF is set to zero if no preference for the assignment algorithm. The lifetime field is set to the minimum desired lifetime, or zero otherwise.

2. Assuming no errors occur, the node will receive an NA message with a GAAO option with a length increased by two compare to the corresponding NS message, because of the presence of the address/prefix field. All fields have been copied back except for:

   * Pfxlen: now indicating the length of the prefix.

   * C: The C bit is set if the 6LR requests a confirmation via a registration procedure.

   * AAF: Indicating the Address Assignment Function, i.e., the algorithm, used to assign the address/prefix. If the node is a 6LR it will use the same AAF to generate addresses/prefixes to requesting neighbors nodes.

   * Assigned lifetime: the maximum lifetime of the assigned address/prefix.

The message sequence is depicted in Figure 3.

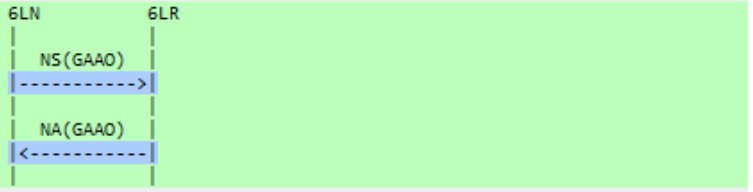


Figure 3: Address/Prefix assignment with GAAO message sequence and no confirmation request.

7.1. Request Phase

When the node requests an address, the node will go through the following steps:

1. The node will issue an NS message with the GAA Option to request an address assignment. This initial GAA Option has a length equal to ROVR's length as a multiple of 8 bytes plus one (no address appended), Status/PfxLen set to 0. Opaque, as well as the F-bit and I-bits will be set according to local configuration. The C-bit is set to zero. The P-bits are set according to the type of address it is requesting. The AAF is set to zero if the node has no preference for the assignment algorithm, otherwise it is set to the selected AAF code. The lifetime field is set to the minimum desired lifetime, or zero otherwise.

2. Assuming no errors occur, the node will receive an NA message with a GAA Option with a length increased by two, compared to the corresponding NS message, because of the presence of the address/prefix field. All fields have been copied back except for:

   * Pfxlen: now indicating the length of the prefix.

   * C: The C bit is set if the 6LR requests a confirmation via a registration procedure.

   * AAF: It is the algorithm, used to assign the address/prefix. If the node is a 6LR it will use the same AAF to generate addresses/prefixes to requesting neighbor nodes.

   * Assignment lifetime: The maximum lifetime of the assigned address/prefix.

The message sequence is depicted in Figure 3.

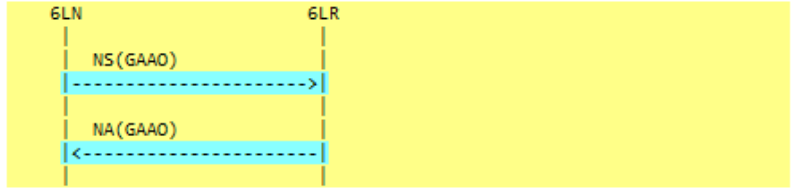


Figure 3: Address/Prefix assignment with GAAO message sequence and no confirmation request.

- Text re-organized in an explicit Request Phase subsection

Optional Confirmation Phase

Depending on the algorithm in use and the underlying technology the address assignment procedure terminates after these two messages. This may be sufficient for instance in deployments where the link layer offers reliable packet delivery.

If the C bit is set, to confirm the acceptance and usage of the proposed address/prefix received in the NA message, the 6LN has to register to the obtained address following the procedures in [RFC8505], [I-D.ietf-6lo-multicast-registration], or [I-D.thubert-6lo-prefix-registration] depending on the type of address.

In the case the complete sequence of actions is depicted in Figure 4.

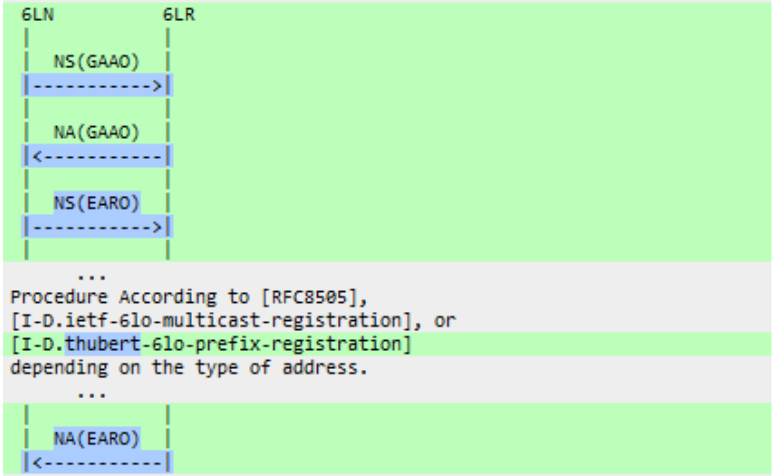


Figure 4: Address/Prefix assignment with GAAO message sequence.

7.2. Optional Confirmation Phase

Depending on the algorithm in use and the underlying technology the address assignment procedure terminates after these two messages. This may be sufficient for instance in deployments where the link layer offers reliable packet delivery. The use of this option is done by configuration. Documents defining Address Allocation Function MUST explicitly state whether this phase remains optional or is mandatory due to factors specific to the proposed algorithm.

If the C bit is set, to confirm the acceptance and usage of the proposed address/prefix received in the NA message, the 6LN MUST register with the obtained address by following the procedures in [RFC8505], [I-D.ietf-6lo-multicast-registration], or [I-D.ietf-6lo-prefix-registration] depending on the type of address.

In this case, the complete sequence of actions is depicted in Figure 4.

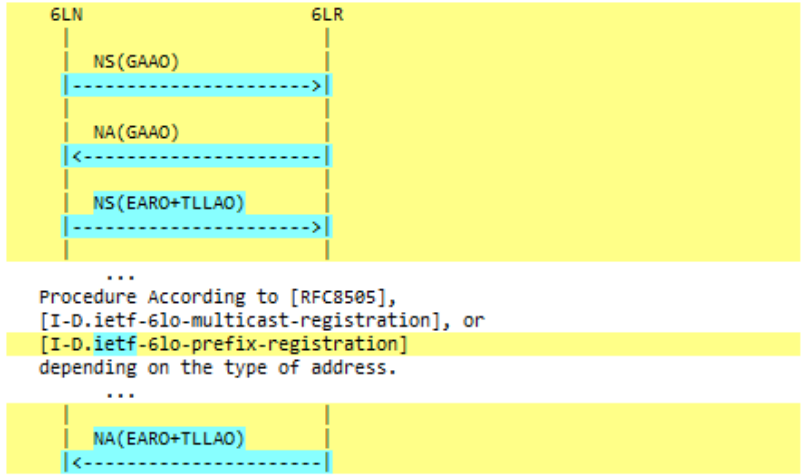


Figure 4: Address/Prefix assignment with GAAO message sequence.

The specifications in [RFC8505], [I-D.ietf-6lo-multicast-registration], and [I-D.ietf-6lo-prefix-registration], define how nodes can keep address/prefix registering state so to maintain addressing in case of reboot. When needed, in order to use this feature with GAAO, after reboot the optional confirmation phase MUST be used to perform an explicit registration. However, when using GAAO, and when preforming the re-registering, if a "Registration Refresh Request" or "Invalid Registration" status value is returned, the node MUST restart from the top with the initial request phase.

- Text re-organized in an explicit Optional Confirmation Phase subsection
- Added text about reboot
  1. At boot time, if state available in non-volatile memory then just re-register addresses
     - In case of error, restart from request phase
  2. Otherwise, if no state available in non-volatile memory, start from request phase

Message exchange optimisation

7.3. Message exchange optimization

The request of a prefix/address uses a NS/NA transaction likewise prefix/address registration. In order to reduce the number fo transactions the GAA Option MAY be used at the same time like the EARO+SLLAO options. In other words the GAA Option can be picky-bagged on other transactions. For instance, it can be picky-bagged in an link-layer address registration, as shown in Figure 5. In this case the returning NA will contain two addresses, one in the TLLA Option, namely the registered link-layer-address, and one directly appended in the GAA Option, namely the offered prefix/address.

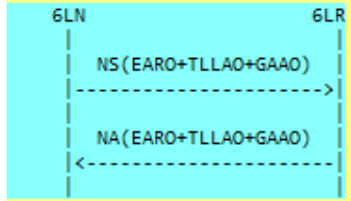


Figure 5: Message sequence when GAA Option is picky-bagged on a link-layer registration transaction.

When prefix/address request is performed at boot time, the GAAO request MAY be appended as an option of the first RS message, implicitly signaling that the node sending the RS message supports the specifications in the present document. In the same way, the responding routers that support this document send back a prefix/address offer in a GAA Option appended to the returning RA message, as depicted in Figure 6.

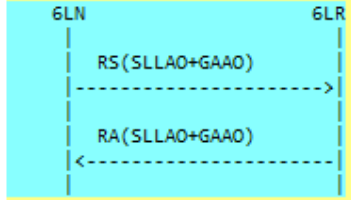


Figure 6: Message sequence when GAA Option is used with the RS/RA transaction.

6LRs that do not support GAAO will simply ignore the option, and the corresponding RA, which will not include the GAA Option, implicitly signaling that the feature is not supported.

- GAA Option usage with other options
- GAAO can be used during a registration transaction
  - The registered address in the TLLAO
  - The GAAO assigned address is directly appended to the GAA Option
- GAAO can be used with RS/RA exchange
  - Option is ignored if not supported

Next Steps

- Document relatively stable
- Time to consider WG Adoption?
- All help and feedback is welcome ;-)

THANKS!