IPv6 Neighbor Discovery Prefix Registration

draft-ietf-6lo-prefix-registration

IETF 123

Mddrid

6LoWPAN ND (IPv6 Stateful Address Autoconfiguration)

RFC 6775 (original 6LoWPAN ND)

Defines ARO for registration and DAD operations for stateful AAC

RFC 8505 (Issued 11/2018)

The protocol agnostic registration for ULA/GUA for proxy ND and routing services

Analogous to a Wi-Fi association but at Layer 3: a deterministic and query-able state for all addresses

RFC 8929 (Issued 11/2020)

Federates 6lo meshes over a high-speed backbone

ND proxy analogous to Wi-Fi bridging but at Layer 3

RFC 8928 (Issued 11/2020)

Protects addresses against theft (Crypto ID in registration)

RFC 9685 (Issued 11/2024)

Extends RFC 8505 for multicast and anycast

draft-thubert-6lo-unicast-lookup

Provides a 6LBR on the backbone to speed up DAD and lookup

Coexistence with classical ND

draft-ietf-6lo-prefix-registration

Extends RFC 8505 for prefixes

News

- IESG review cycle complete (RFC editor queue)
- Many thanks to all reviewers, Shuping Peng, Mohamed Boucadair, Paul Wouters, Ketan Talaulikar, Gunter Van de Velde, Mike Bishop, Roman Danyliw, … And our A-D Eric Vyncke.
- Restored use of “Updates”
- C-field discussion moved in ‘n’ out

Addition N°1: Justify Design Points for LLN

6LoWPAN was a pioneering attempt at the IETF to design protocols that conserve energy, with the primary goal to serve LLNs, though the general design could be applied in other environments where lowering carbon emissions is also a priority. The general design points include:

* Placing the protocol complexity in the routers to simplify the host implementation and avoid expanding the control traffic to all nodes.

* Restful operations from the host perspective to enable transient disconnections where the power usage can be lowered.

Examples of LLNs include hub-and-spoke access links such as (Low-Power) Wi-Fi [IEEE80211] and Bluetooth (Low Energy) [IEEE802151], Mesh-Under networks where the routing operation is handled at Layer-2, and Route-Over networks such as the Wi-SUN [WI-SUN] and 6TiSCH [RFC9030] mesh networks, which leverage 6LoWPAN [RFC4919][RFC6282] and RPL [RFC6550] over [IEEE802154].

LLNs and constrained devices are the original domain of application for 6LoWPAN protocols. It is thus a foremost concern, when designing those protocols, to minimize energy spendings. In non-LLN environments where lowering carbon emissions is also a priority, it could make sense to apply the 6LoWPAN designs and extend some of the 6LoWPAN protocols. The general design points include:

* Placing the protocol complexity in the less-constrained routers to simplify the host implementation and avoid expanding the control traffic to all nodes.

* Using host-triggered operations to enable transient disconnections with the routers, e.g., to conserve power (sleep), but also to cope with inconsistent connectivity.

Addition N°2: New operational considerations

11. Backward Compatibility

A legacy 6LN will not register prefixes and the service will be the same when the network is upgraded. A legacy 6LR will not set the F flag in the 6CIO and an upgraded 6LN will not register prefixes.

Upon an EDAR message, a legacy 6LBR may not realize that the address being registered is anycast or multicast, and return that it is duplicate in the EDAC status. The 6LR MUST ignore a duplicate status in the EDAR for anycast and multicast addresses.

12. IANA Considerations

12. Operational Considerations

12.1. Partially Upgraded Networks

A mix of devices that support only [RFC8505], both [RFC8505] and [RFC9685], and all of the above plus this specification, may coexist. Different cases may occur:

* A legacy 6LN will not register prefixes and the service will be the same when the network is upgraded.

* A legacy 6LR will not set the F flag in the 6CIO and an upgraded 6LN will not register prefixes with that router, though it may with other 6LRs that do support this specification.

* Upon an EDAR message, a legacy 6LBR may not realize that the address being registered comes with a whole prefix, and return that it is duplicate in the EDAC status. The 6LR MUST ignore a duplicate status in the EDAR for prefixes.

12.2. Application to RPL-Based Route-Over LLNs

This specification also updates [RFC6550] and [RFC9010] in the case of a route-over multilink subnet based on the RPL routing protocol, to add multicast ingress replication in Non-Storing Mode and anycast support in both Storing and Non-Storing modes. A 6LR that implements

Addition N°3: EDAR and EDAC

Figure 6 illustrates the EDAR message when the value of the P field is 3.

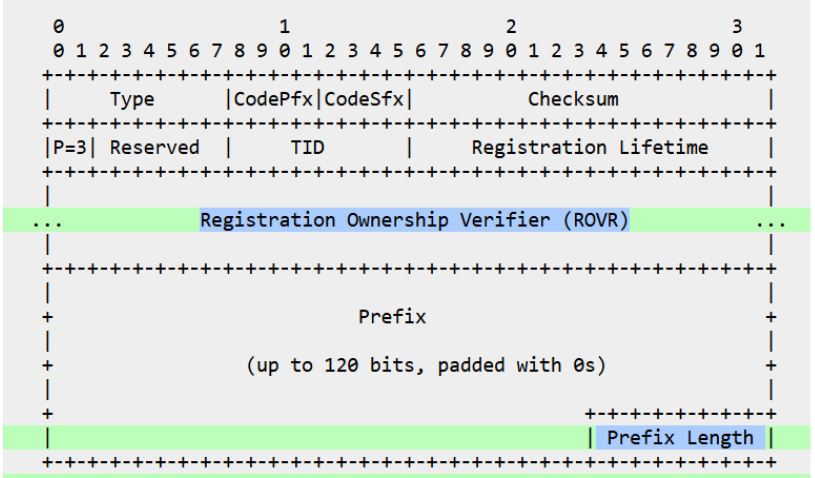

Figure 6: EDAR Message Format with P == 3

Figure 3 illustrates the EDAR message when the value of the P-Field is 3. Figure 4 shows the response EDAC message, with the Status field and the echoed Prefix.

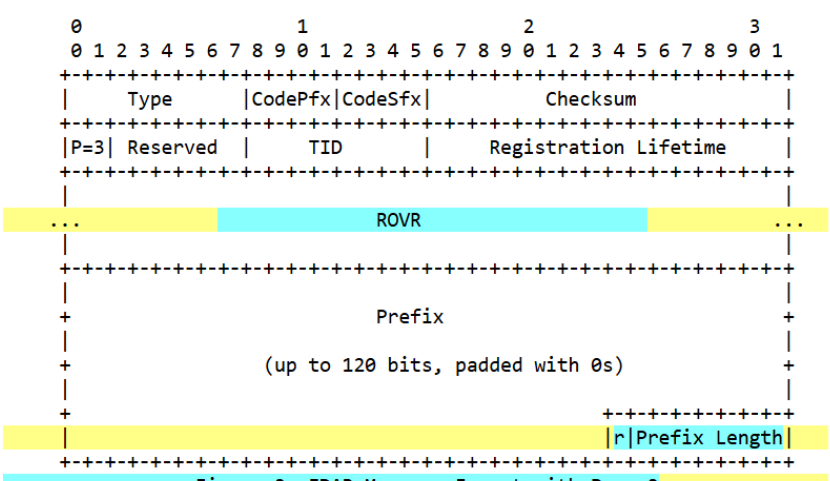

Figure 3: EDAR Message Format with P == 3

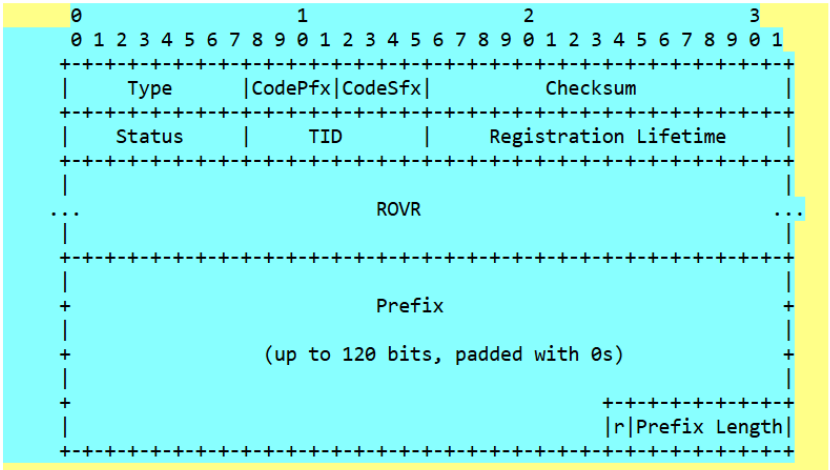

Figure 4: EDAC Message Format

Addition N°4: Updating BBR

10. Security Considerations

This specification extends [RFC8505], and the security section of that document also applies to this document. In particular, the link layer SHOULD be sufficiently protected to prevent rogue access.

10. Updating RFC 8929

"IPv6 Backbone Router" [RFC8929] defines a proxy operation whereby a 6LoWPAN Border Router (6LBR) may impersonate a 6LN when performing an address registration. In that case, [RFC8505] messages are used as is, with one change that the SLLAO in the proxied NS(EARO) messages indicates the Registering Node (the 6LBR) as opposed to the Registered Node (the 6LN). See figure 5 of [RFC8929] for an example of proxy operation by the 6LBR, which generates an NS(EARO) upon receiving an EDAR message.

This specification updates that proxy operation with the updates in [RFC9685] and this on the formats and content of the EARO, the EDAR, and the EDAC messages, to support the P-Field and the signaling of prefixes. The proxy MUST use the P-Field as received in the EDAR or NS(EARO) message to generate the proxied NS(EARO), and it MUST use the exact same prefix and prefix length as received in the case of a prefix registration.

11. Security Considerations

This specification updates [RFC8505], and the security section of that document also applies to this document. In particular, the link layer SHOULD be sufficiently protected to prevent rogue access, else a rogue node with physical Access to the network may inject packets and perform an attack from within.

Addition N°5: Change capability Bit

12.2. New 6LoWPAN Capability Bit

IANA is requested to make an addition to the "6LoWPAN Capability Bits" [IANA.ICMP.6CIO] registry under the heading "Internet Control Message Protocol version 6 (ICMPv6) Parameters" as indicated in Table 3:

Capability Bit	Meaning	Reference
7 (suggested)	F flag: Registration for prefixes Supported (F)	This RFC

Table 3: New 6LoWPAN Capability Bit

13.2. New 6LoWPAN Capability Bit

IANA is requested to make an addition to the "6LoWPAN Capability Bits" [IANA.ICMP.6CIO] registry under the heading "Internet Control Message Protocol version 6 (ICMPv6) Parameters" as indicated in Table 3:

IANA is also requested to fix the description of bit 9 (the "A" flag defined in [RFC8928]). It is not called "1" but "A".

Bit	Description	Reference
9	AP-ND Enabled (A bit)	[RFC8928]
16 (suggested)	Registration for prefixes Supported (F bit)	This RFC

Thanks!

Questions?