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**Prefix Exclude Option for DHCPv6-based Prefix Delegation**  
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Abstract

This specification defines an optional mechanism to allow exclusion of one specific prefix from a delegated prefix set when using DHCPv6-based prefix delegation. The new mechanism updates [RFC 3633](#).

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## **1. Introduction**

This specification defines an optional mechanism and the related DHCPv6 option to allow exclusion of one specific prefix from a delegated prefix set when using DHCPv6-based prefix delegation.

The prefix exclusion mechanism is targeted to deployments where DHCPv6-based prefix delegation is used but a single aggregated route/prefix has to represent one customer, instead of using one prefix for the link between the delegating router and the requesting router and another prefix for the customer network. The mechanism defined in this specification allows a delegating router to use a prefix out of the delegated prefix set on the link through which it exchanges DHCPv6 messages with the requesting router, and is intended for use in networks where each requesting router is on its own layer 2 domain.

## **2. Requirements and Terminology**

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 [[RFC2119](#)].

## **3. Problem Background**

DHCPv6 Prefix Delegation (DHCPv6-PD) [[RFC3633](#)] has an explicit limitation described in [Section 12.1 of \[RFC3633\]](#) that a prefix delegated to a requesting router cannot be used by the delegating router. This restriction implies that the delegating router will have two (non aggregatable) routes towards a customer, one for the link between the requesting router and the delegating router, and one for the customer site behind the requesting router.

There are architectures and link models, where a host (e.g. a mobile router, also acting as a requesting router) always has a single (/64) prefix configured on its uplink interface and the delegating router is also requesting router's first hop router. Furthermore, it may be required that the prefix configured on the uplink interface has to be aggregatable with the delegated prefixes. This introduces a problem in how to use DHCPv6-PD together with stateless [[RFC4862](#)] or stateful [[RFC3315](#)] address autoconfiguration on a link, where the /64 advertised on the link is also part of the prefix delegated (e.g /56) to the requesting router.



## 4. Solution

### 4.1. Prefix Delegation with Excluded Prefixes

This specification defines a new DHCPv6 option, `OPTION_PD_EXCLUDE` (TBD1), that is used to exclude exactly one prefix from a delegated prefix. The `OPTION_PD_EXCLUDE` is included in the `OPTION_IAPREFIX` IAPrefix-options field. There can be at most one `OPTION_PD_EXCLUDE` option in one `OPTION_IAPREFIX` option. The `OPTION_PD_EXCLUDE` option allows prefix delegation where a requesting router is delegated a prefix (e.g. /56) and the delegating router uses one prefix (e.g. /64) on the link through which it exchanges DHCPv6 messages with the requesting router with a prefix out of the same delegated prefix set.

A requesting router includes an `OPTION_ORO` option with the `OPTION_PD_EXCLUDE` option code in a Solicit, Request, Renew, or Rebind message to inform the delegating router about the support for the prefix delegation functionality defined in this specification. A delegating router may include the `OPTION_PD_EXCLUDE` option code in an `OPTION_ORO` option in a Reconfigure message for indicating that the requesting router should request `OPTION_PD_EXCLUDE` from the delegating router.

The delegating router includes the prefix in the `OPTION_PD_EXCLUDE` option that is excluded from the delegated prefix set. The requesting router **MUST NOT** assign the excluded prefix to any of its downstream interfaces.

### 4.2. Prefix Exclude Option

```

      0               1               2               3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|          OPTION_PD_EXCLUDE          |          option-len          |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| prefix-len | IPv6 subnet ID (1 to 16 octets) | ~
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

#### Prefix Exclude Option

- o option-code: `OPTION_PD_EXCLUDE` (TBD1).
- o option-len: 1 + length of IPv6 subnet ID in octets. A valid option-len is between 2 and 17.
- o prefix-len: The length of the excluded prefix in bits. The prefix-len **MUST** be between 'OPTION\_IAPREFIX prefix-length'+1 and



128.

- o IPv6 subnet ID: A variable length IPv6 subnet ID up to 128 bits.

The IPv6 subnet ID contains prefix-len minus 'OPTION\_IAPREFIX prefix-length' bits extracted from the excluded prefix starting from the bit position 'OPTION\_IAPREFIX prefix-length'. The extracted subnet ID MUST be left shifted to start from a full octet boundary, i.e. left shift of 'OPTION\_IAPREFIX prefix-length' mod 8 bits. The subnet ID MUST be zero padded to the next full octet boundary.

The encoding of the IPv6 subnet ID can be expressed in a C-like pseudo code as shown below:

```
uint128_t p1;           // the delegated IPv6 prefix
uint128_t p2;           // the excluded IPv6 prefix
uint16_t a;             // the OPTION_IAPREFIX prefix-length
uint8_t b;              // the excluded IPv6 prefix length
uint8_t s;

// sanity checks

s = 128-a;               // size of non-prefix bits
assert(b>a);             // b must be at least a+1
assert(p1>>s == p2>>s); // p1 and p2 must share a common
                        // prefix of 'a' bits

// calculate the option content

uint16_t c = b-a-1;      // the IPv6_subnet_ID_length-1 in bits
uint16_t d = (c/8)+1;    // the IPv6_subnet_ID_length in octets
uint128_t p = p2<<a;     // p is the IPv6 subnet ID that has the
                        // common p1 prefix left shifted out to
                        // a full octet boundary (trailing bits
                        // are zeroed)

// populate the option

uint8_t* id = &OPTION_PD_EXCLUDE.IPv6_subnet_ID;
OPTION_PD_EXCLUDE.option_len = d+1;
OPTION_PD_EXCLUDE.prefix_len = b;

while (d-- > 0) {
    *id++ = p>>120;
    p <<= 8;
}
```

The OPTION\_PD\_EXCLUDE option MUST only be included in the





OPTION\_IAPREFIX IAprefix-options [[RFC3633](#)] field.

Any prefix excluded from the delegated prefix MUST be contained in OPTION\_PD\_EXCLUDE options within the corresponding OPTION\_IAPREFIX.

The prefix included in the OPTION\_PD\_EXCLUDE option share the same preferred-lifetime and valid-lifetime as the delegated prefix in the encapsulating OPTION\_IAPREFIX option.

The prefix in the OPTION\_PD\_EXCLUDE option MUST be part of the delegated prefix in the OPTION\_IAPREFIX. For example, the requesting router has earlier been assigned a 2001:db8:dead:beef::/64 prefix by the delegating router, and the delegated prefix in the OPTION\_IAPREFIX is 2001:db8:dead:bee0::/59. In this case, 2001:db8:dead:beef::/64 is a valid prefix to be used in the OPTION\_PD\_EXCLUDE option. The OPTION\_PD\_EXCLUDE option would be encoded as follows:

```

      0              1              2              3
      0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|          OPTION_PD_EXCLUDE          |          2          |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|          64          |0|1|1|1|1|0|0|0|
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
                        ^           ^
                        |           |
                        |           +- 3 zero padded bits follow
                        |
                        +- using C syntax: 0xef << (59 % 8)
                          Note: 59 mod 8 = 3

```

## 5. Delegating Router Solicitation

The requesting router locates and selects a delegating router in the same way as described in [Section 11 \[RFC3633\]](#). This specification only describes the additional steps required by the use of OPTION\_PD\_EXCLUDE option.

### 5.1. Requesting Router

If the requesting router implements the solution described in [Section 4.1](#) then the requesting router SHOULD include the OPTION\_PD\_EXCLUDE option code in the OPTION\_ORO option in Solicit messages.

Once receiving Advertise message, the requesting router uses the prefix(es) received in OPTION\_PD\_EXCLUDE in addition to the



advertised prefixes to choose the delegating router. Requesting router MUST proceed to Prefix Delegation procedure described in [Section 6.1](#). If Advertise message did not include OPTION\_PD\_EXCLUDE option, then the requesting router MUST fall back to normal [\[RFC3633\] Section 11.1](#) behavior.

## **5.2. Delegating Router**

If the OPTION\_ORO option in the Solicit message includes the OPTION\_PD\_EXCLUDE option code, then the delegating router knows that the requesting router supports the solution defined in this specification. If the Solicit message also contains an IA\_PD option, the delegating router can delegate to the requesting router a prefix which includes the prefix already assigned to the requesting router's uplink interface. The delegating router includes the prefix originally or to be assigned to the requesting router in the OPTION\_PD\_EXCLUDE option within the OPTION\_IAPREFIX IAprefix-option in the Advertise message.

If the OPTION\_ORO option in the Solicit message does not include the OPTION\_PD\_EXCLUDE option code, then the delegating router MUST fall back to normal [\[RFC3633\] Section 11.2](#) behavior.

If the OPTION\_ORO option in the Solicit message includes the OPTION\_PD\_EXCLUDE option code but the delegating router does not support the solution described in this specification, then the delegating router acts as specified in [\[RFC3633\]](#). The requesting router MUST in this case also fall back to normal [\[RFC3633\]](#) behavior.

## **6. Requesting Router Initiated Prefix Delegation**

The procedures described in the following sections are aligned with [Section 12 of \[RFC3633\]](#). In this specification we only describe the additional steps required by the use of OPTION\_PD\_EXCLUDE option.

### **6.1. Requesting Router**

The requesting router behavior regarding the use of the OPTION\_PD\_EXCLUDE option is more or less identical to step described in [Section 5.1](#). The only difference really is different used DHCPv6 messages. The requesting router SHOULD include the OPTION\_PD\_EXCLUDE option code in the OPTION\_ORO option in DHCPv6 messages as described in [Section 22.7 of \[RFC3315\]](#).

The requesting router uses a Release message to return the delegated prefix(es) to a delegating router. The prefix(es) to be released MUST be included in the IA\_PDs along with the excluded prefix



included in the `OPTION_PD_EXCLUDE` option. The requesting router **MUST NOT** use the `OPTION_PD_EXCLUDE` option to introduce additional excluded prefix in the Release message that it originally got a valid binding for.

The requesting router must create sink routes for the delegated prefixes minus the excluded prefixes. This may be done by creating sink routes for delegated prefixes and more specific routes for the excluded prefixes.

## **6.2. Delegating Router**

The delegating router behavior regarding the use of the `OPTION_PD_EXCLUDE` option is more or less identical to step described in [Section 5.2](#). The only difference really is DHCPv6 messages used to carry the `OPTION_PD_EXCLUDE` option.

The delegating router may mark any prefix(es) in `IA_PD` Prefix options in a Release message from a requesting router as 'available' excluding the prefix included in the `OPTION_PD_EXCLUDE` options. If the Release message contains 'new' excluded prefix in any `OPTION_PD_EXCLUDE` option, the delegating router **MUST** send a Reply message with Status Code set to NoBinding for that `IA_PD` option.

## **7. Security Considerations**

Security considerations in DHCPv6 are described in [Section 23 of \[RFC3315\]](#), and for DHCPv6 Prefix Delegation in [Section 12 of \[RFC3633\]](#).

## **8. IANA Considerations**

A new DHCPv6 Option Code is reserved from DHCPv6 registry for DHCP Option Codes.

`OPTION_PD_EXCLUDE` is set to TBD1

## **9. Acknowledgements**

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## **10. References**

### **10.1. Normative References**

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### **10.2. Informative References**

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