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Internet-Draft Ecole Polytechnique/Telecom ParisTech
Intended status: Informational G. Campo
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April 17, 2018

DHCPv6_PD, PDP and NDP Implementation in IoT Router (DANIR)
draft-shytyi-v6ops-danir-01.txt

Abstract

This document provides a description of the implementation of Dynamic Host Configuration Protocol version 6 Prefix Delegation, Neighbour Discovery Protocol and of the use of the Packet Data Protocol in an Internet of Things Router. This Internet of Things Router is connected on a cellular network; it is a DHCPv6-PD Client and it requests a /56 pool of prefixes from the server; the DHCPv6-PD server is placed in the PGW and is a part of the cellular infrastructure. After the pool of prefixes is delegated, the Internet of Things Router derives sub-prefixes from the prefix pool; each one of these sub-prefixes is aimed at one ingress interface.

After the Internet of Things Router finishes the network prefix assignment procedure, it advertises the network prefixes on the ingress links by using the Neighbour Discovery protocol. Finally, when Hosts receive the sub-prefixes via Router Advertisement messages, they configure the Global Unique Address with the Stateless Address Auto-configuration protocol.

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1. Introduction

This document describes the implementation of the Dynamic Host Configuration Protocol vestion 6 with Prefix Delegation (DHCPv6_PD), Neighbour Discovery Protocol (NDP) and usage of the Packet Data Protocol (PDP) in an Internet of Things (IoT) Router.

The use of DHCPv6 Prefix Delegation in LTE networks is overviewed in

[RFC6653]. It misses several important aspects.

The router is a node that forwards IP version 6 packets not explicitly addressed to itself [RFC8200]. Thus, it has more than one link to perform the forwarding. With multiple links, the need of

multiple global unique network prefixes (GUNPs) , assigned to those links, appears. To assign the GUNPs to the links, the Requesting IoT Router Solicits the pool of GUNPs.

First, the Requesting IoT Router solicits the pool of the GUNP from the Delegating Router.

After the pool is received, the Requesting IoT Router (1) derives GUNPs and (2) performs address autoconfiguration. During the autoconfiguration process the Requesting IoT Router assigns the GUNPs to the links. When the IoT Router finishes the GUNPs assignment procedure, it starts to advertise the GUNPs on the links with NDP [RFC4861]. Meanwhile, the Hosts that are connected to the Requesting IoT Router run the SLAAC mechanism to perform the GUA IP version 6 autoconfiguration.

2. 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 RFC 2119 [RFC2119].

Router - is a node, that performs forwarding. Router node is not a final destination of forwarded packets.

Delegating Router - is a node, DHCPv6 server, that chooses prefix(es) for delegation and advertises them to the Requesting Router [RFC3633].

Requesting IoT Router - is a node that behaves as DHCPv6 client. It requests the network prefix(es) and assigns network prefix(es) to the interfaces [RFC6653].

Host - is a node that is not a router.

Link - is an entity that enables link layer communication of nodes.

Interface - node connection to the link.

Link-local address - is an address with usage that is limited by a link.

Global Unique Address (GUA) - is an address that is globally available and globally unique.

3. Overview

This section provides an overview of the actions performed on the Delegating Router, Requesting IoT Router and host to perform address assignment on the interfaces with different GUNP. The process of IP version 6 address assignment starts with advertising of the GUNP pool from the Delegating Router to the Requesting IoT Router. To perform such a solicitation, the Requesting IoT Router runs the DHCPv6_PD.

```
                        +-----------------+
                        |                 |
                        |    Delegating   |
                        |     router      |
                        |                 |
                        | (DHCPv6 server) |
                        +-----------------+
                                |
                                |DHCPv6_PD network prefix
                        POOL    |2001:DB8:XYZU:TVWZ::/56
                                |
                                | GUA Prefix_0 /64
                                |interface_0
                +--------------------------------+
                |                                |
                |          Requesting            |
                |          IoT router            |
                |                                |
                |(DHCPv6_PDclient + RADVDserver)|
```

```
         +-------------------------------+
         |interface_1    |interface_2    |interface_3
         |               |               |
   GUNP  |Prefix_1 /64   |Prefix_2 /64   |Prefix_3 /64
         |SLAAC GUA      |SLAAC GUA      |SLAAC GUA
 +-------------+  +-------------+  +-------------+
 |             |  |             |  |             |
 |   Host 1    |  |   Host 2    |  |   Host 3    |
 |             |  |             |  |             |
 +-------------+  +-------------+  +-------------+
```

(In the above figure the scenario with 3 hosts connected to the Requesting IoT router is presented. Normally there are no number limitations of connected hosts.)

When the DHCPv6 message exchange is performed, the Requesting IoT Router receives the pool of IPv6 GUNPs. After the pool of GUNPs is received, the Requesting IoT Router performs the autoconfiguration.

Precisely, when the Requesting IoT Router's interface is attached on the link, the Requesting IoT Router assigns to this link the GUNP taken from GUNP pool. The Requesting IoT Router performs the GUNP assignment procedure for multiple links over the interfaces. Finally, this mechanism offers the automated assignment of GUNPs to the links. At the moment of autoconfiguration, the Requesting IoT Router's interfaces are already assigned with link local addresses.

The next step of the autoconfiguration phase is performed using the Neighbor Discovery protocol. The latter advertises the network's configuration on the links with different interfaces thus with different GUNPs. To perform the GUNPs advertisement, the Requesting IoT ROuter sends the "Router Advertisement Messages" via its interfaces. The Router Avertisement Messages carry the GUNPs that are further used by the stateless autoconfiguration mechanism (SLAAC). There exists an open source implementation of Neighbor Discovery protocol - RADVD sever. With RADVD it is possible to configure hosts interfaces connected to the router's interfaces in automatic manner. It is possible thanks to the fact that hosts run the SLAAC.

The IP version 6 stateless autoconfiguration mechanism enables hosts to perform the address autoconfiguration. The SLAAC mechanism is used when it is enough to have random unique IP version 6 addresses [RFC4862]. The length of the IP version 6 address is N bytes. The first part of the address (128-N bits) consists of the GUNP information associated with a link. The network prefix is advertised by the IoT Router on the link. The second part of the address (8 bytes) consists of interface identifier on the link. The interface identifier is generated locally and randomly.

```
+-------------------------------------+------------------------+
|              128 - N bits           |         N bits         |
+-------------------------------------+------------------------+
|              link prefix            |  interface identifier  |
+--------------------------------------------------------------+
```

(In the above figure, an IP version 6 address scheme is presented [RFC4862].)

3.1. Environment

This section describes the location of the Delegating Router and the Requesting IoT Router in the cellular provider's infrastructure model. The model is not a real cellular provider infrastructure.

After the DHCPv6 packet leaves the cellular interface of the IoT Requesting Router via wireless OFDMA link, it reaches the element of the access network which connects to the user equipment (UEs) - eNodeB station.

Further, the packet is transmitted to the Serving Gateway (SGW), as all the user's IP packets. SGW is used to enable the UE movement between eNodeBs. When the UE moves between eNodeBs, the SGW keeps information about the bearers.

The final destination of the DHCPv6 packet is the Packet Data Network Gateway, that is responsible for IP address allocation for the UE and for filtering of down-link user's IP packets into the different QoS-based bearers.

The model of the infrastructure described in this this section is a simplified example. Real infrastructure construction could contain multiple SGW and eNodeBs and network equipment (that is not described in the current example) with respect of existing standards.


```
 +----------------+        |
 |      PGW       |        |
 |   Delegating   |        |
 |     Router     |        |
 +----------------+        |
         |                 |
         |                 |
 +----------------+        |
```

```
                     |      SGW      |       | Cellular infrastructure
                     +---------------+       |
                             |               |
                             |               |
                     +---------------+       |
                     |    eNodeB     |       |
                     +---------------+       |
                             |               |
                             |               |
                             ~               ~  Wireless OFDMA 3G/4G
                             |               |
                     +---------------+       |
                     |   +--------+  |       |
                     |   | Modem  |  |       |
                     |   +--------+  |       |
                     |       |       |       |
                     |   +--------+  |       |
                     |   |  ARM   |  |       |
                     |   +--------+  |       |
                     |   Requesting  |       |  User Equipment
                     |      IoT      |       |
                     |     Router    |       |
                     +---------------+       |
```

(The above figure descibes the model of the path followed by a DHCPv6 packet from IoT requesting router to the Delegating PGW router. The model is not a real infrastructure.)

Additional experiments with using of USB dongle were performed. The following figure illustrates the successful DHCPv6-PD test on Orange with dongle. It uses a Huawei E392 USB dongle on laptop (and not the Sierra Wireless mangOH Red).


```
                     +---------------+       |
```

```
                     |      PGW      |       |
                     |   Delegating  |       |
                     |     Router    |       |
                     +---------------+       |
                             |               |
                             |               |
                     +---------------+       |
                     |      SGW      |       | Cellular infrastructure
                     +---------------+       |
                             |               |
                             |               |
                     +---------------+       |
                     |    eNodeB     |       |
                     +---------------+       |
                             |               |
                             |               |
                             ~               ~  Wireless OFDMA 3G/4G
                             |               |
                     +---------------+       |
                     |   +--------+  |       |
                     |   |  E392  |  |       |
                     |   |  USB   |  |       |
                     |   | dongle |  |       |
                     |   +--------+  |       |
                     |       |       |       | User Equipment
                     |   +--------+  |       |
                     |   | Laptop |  |       |
                     |   +--------+  |       |
                     |               |       |
                     +---------------+       |
```

4. Specification

This section presents the process that starts with delegation of Network Prefix pool 2001:DB8:XXXX:XX::/56 from the Delegation Router and finishes with the configuration of IPv6 prefixes on the hosts interfaces. Each Requesting IoT router's interface acts on a unique link. The Host's interfaces, connected to the Requesting IoT router, acts on the same unique links as the Requesting IoT router's interfaces.

4.1. Solicitation of the network prefix pool

4.1.1. The Packet Data Protocol

This section describes how the Requesting IoT Router obtains the GUA address on the Recipient Interface (RI) (OFDMA interface, 3GPP interface). The message "Activate PDP context Accept" is useful for forming the Globally Unique Address on the RI.

The Packet Data Protocol [ETSI102361]contains the following types of DLL (Data Link Layer) bearer service data transmissions: unconfirmed data transmission; confirmed data (data transmission; response transmission.) The Packet Data Protocol contains the following types of layer 3 bearer service data transmissions: Internet Protocol; Short Data. These layer 3 bearer services are built on the top of DLL services.

```
                    ARM     Modem      eNodeB     SGW  PGW
                    |        |          |         |    |
                    |        |  PDP     |         |PDP |
                    |        |--------->|         |--->|
                    |        |          |         |    |
                    |        |<---------|         |<---|
                    |        |          |         |    |
                    |        |          |         |    |
```

4.1.2. The Dynamic Host Configuration Protocol version 6 with Prefix Delegation

To perform the pool solicitation, the Prefix Delegation options of the Dynamic Host Configuration Protocol version 6 (DHCPv6) are used [I-D.ietf-dhc-rfc3315bis].

The Requesting IoT Router sends the DHCPv6 "Solicit" packet to the Delegating Router via the wireless link. The DHCPv6 "Solicit" packet consists of Client Identifier, Transaction ID, Elapsed time and Identity Association for Prefix Delegation (IA_PD) options. The initial "Solicit" packet triggers the 4 message exchange, that finishes with the reception of the GUNPs pool by the Requesting IoT Router.

```
          +-------------+                        +-----------+
          | Requesting  |                        |    PGW    |
          |    IoT      |                        |Delegating|
          |   Router    |                        |  Router   |
          +-------------+                        +-----------+
                |                                       |
                |                                       |
                |1 Solicit                              |
                |--------------->                       |
                |                                       |
                |                       2 Advertise     |
                |                       <---------------|
                |                                       |
                |3 Request                              |
                |--------------->                       |
                |                                       |
                |                                       |
                |                       4 Reply         |
                |                       <---------------|
                |                                       |
                |                                       |
                |                                       |
```

(In the above figure the full DHCPv6 message exchange mechanism between the ARM part of UE and PGW is presented.)

The IA_PD option consists of the Identity Association (IA) - group identifier [RFC3633], parameters (IA id, times to extend the lifetimes of prefixes and prefixes allocated to the IA). The full description of the IA_PD option is presented in the RFC3633 [RFC3633].

```
 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_IA_PD          |         option-length         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         IAID (4 octets)                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                              T1                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                              T2                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                               .
.                          IA_PD-options                        .
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

(in the above figure the DHCPv6 IA_PD option format [RFC3633].)

The IA_PD-options field carries the IA_PD Prefix Option. The IA_PD Prefix Option carries the recommended preferred/valid life time and IPv6 prefix with prefix length. The additional fields allocated for the options for the advertised GUNP [RFC3633].

```
 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_IAPREFIX        |         option-length         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      preferred-lifetime                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
       |                          valid-lifetime                       |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       | prefix-length |                                               |
       +-+-+-+-+-+-+-+-+          IPv6 prefix                          |
       |                           (16 octets)                         |
       |                                                               |
       |                                                               |
       |                                                               |
       |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |               |                                               .
       +-+-+-+-+-+-+-+-+                                               .
       .                       IAprefix-options                        .
       .                                                               .
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```


(in the above figure the DHCPv6 IA_PD Prefix option format is presented [RFC3633].

The PGW (Delegating Router) advertises, through the usage of a DHCPv6 packet, an IPv6 pool 2001:DB8::/56 to the Requesting IoT Router. The packet is sent from the cellular infrastructure to the Requesting IoT Router, via the wireless link. The full message exchange consists of: Solicit, Advertise, Request and Reply messages.

The "Request", "Reply" messages are used to add/remove/update the assigned prefixes to IA_PDs.

The Hop Limit of packets that contain the DHCPv6 data should be 255 to satisfy the properties of the cellular infrastructure. To reach the PGW from the UE the DHCPv6 packets are encapsulated by SGW into UDP/IPv4 packets; this encapsulation is for the GTP-U tunnel. The corresponding decapsulation mechanism decreases the Hop Limit; when the Hop Limit reaches value 0 the packet is discarded; to avoid this situation it is required to put the Hop Limit value of the DHCPv6 Solicit equal to 255.

4.1.3. Option: PPP use

It is possible to use IPv6-over-PPP protocol, with LCP, between the ARM and the modem. This protocol helps with forming an IPv6 link-local address on the IoT Router's RI.

```
          ARM      Modem       eNodeB      SGW   PGW
           |         |           |          |     |
           |-------->|           |          |     |
           |PPP LCP  |           |          |     |
           |<--------|           |          |     |
           |         |           |          |     |
           |         |           |          |     |
           |         |           |          |     |
```

4.2. Assignment of the network prefixes on the links

The receipt of the IA_PD Prefix option triggers the GUA autoconfiguration on the Requesting IoT Router's interfaces. The Recipient Interface (RI) receives a message with the IA_PD prefix option and does not perform the autoconfiguration on the current stage.

All interfaces, except RI, now follow the GUA autoconfiguration procedure. The number of interfaces that should follow the procedure could be specified in the configuration file of the Requesting IoT Router.

The GUA interface autoconfiguration procedure in the Requesting IoT Router is done by assigning the network addresses from different GUNPs to the links. The assignment of network addresses is performed using the 2001:DB8:XXXX:XX::/56 network pool. Therefore, the Requesting IoT Router operates on multiple links (ingress links).

The IoT Router derives several GUNPs from the received pool. For example, from the pool 2001:db8:XYZU:TVWZ::/56 the GUNPs 2001:db8:XYZU:TV01::/64 and 2001:db8:XYZU:TV02::/64 are derived.

Further, the GUNPs are aimed at links. For example, the GUNP 2001:DB8:XXXX:XX01::/64 is aimed at the interface 1, and 2001:DB8:XXXX:XX02::/64 at the interface 2; further, 2001:DB8:XXXX:XXff::/64 corresponds to the interface interface 256.


```
          ++=======================++
          II                       II
          II                       II
          II                       II
          II                       II                             |H
          II        Prefix 1     +------+          Link 1         |o
          II       +--------+     |  I1 |..........................|s
          II       |  /64  |     +------+  |                      |t
          II       |       |       II     |2001:DB8:XXXX:XX01::/64  |
          II       |       +---------------+                      |1
          II       |               II
```

```
           II       |               II
           II       |               II
           II       |               II                               |H
    /56  +-----+    |Prefix 2     +-----+          Link 2            |o
   ......|  I0 |----+-------+     |  I2 |............................|s
         +-----+    |  /64  |     +-----+  |                         |t
           II       |       |       II     |2001:DB8:XXXX:XX02::/64  |
           II       |       +--------------+                         |2
           II       |               II
           II       |               II
           II       |               II
           II       |               II                               |H
           II       |Prefix 3     +-----+          Link 3            |o
           II       +-------+     |  I3 |............................|s
           II          /64  |     +-----+  |                         |t
           II               |       II     |2001:DB8:XXXX:XX03::/64  |
           II               +--------------+                         |3
           II                       II
           II                       II
           ++=======================++
              Requesting IoT Router
```

(In the above figure the Requesting IoT Router, with 4 links, is presented).

There are 2 cases that could be considered. The first one is: all interfaces (except the RI) of the Requesting IoT Router could be assigned with the corresponding GUNPs. In the second case, a list of manually selected interfaces is obtained. Finally interfaces in the list are assigned with GUNPs. The interfaces numbers represent their position in alphabetically ordered list by the names that operating system assigned to them during the initialization.

During the final step of the GUA autoconfiguration in the Requesting IoT Router, the assignment of the IPv6 network addresses to the interfaces is performed. The IPv6 network addresses have the current

format: 2001:DB8::XXXX:XXYY:1/56, where YY - is a value that represents the number of the interface. When the GUA autoconfiguration on the Requesting IoT Router is finished, the Requesting IoT Router advertises via its interfaces the GUNPs to the

Hosts.

4.3. Advertisement of the network prefixes

Finally, the Requesting IoT Router runs the Neighbour Discovery Protocol. The Neighbour Discovery Protocol messages allow to advertise the configuration to the hosts. To send the configuration parameters from the Requesting IoT Router to the hosts, the "Router Advertisement" type messages are used [RFC4861]. Usually the "Router Advertisement" messages are triggered by the "Router Solicit" messages sent from the Hosts to the Requesting IoT Router [RFC4861].

The "Router Advertisement" message includes the "Prefix Information" option. It is located in the "Options part" of the "Router Advertisement" message. The position of the "Prefix Information" option is presented in the figure below.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |     Code      |          Checksum             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Cur Hop Limit |M|O|  Reserved |       Router Lifetime         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Reachable Time                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Retrans Timer                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Options ...          PREFIX INFORMATION
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
```

(Figure above presents the Router Advertisement message format [RFC4861])

The "Prefix Information" option carries the GUNP value and length. These configuration parameters provide on-link GUNPs, used for SLAAC auto configuration. The Prefix Length is a number that describes the number of bits which are used to identify the GUNP. And each GUNP represents the sub-network.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |    Length     | Prefix Length |L|A| Reserved1 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Valid Lifetime                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Preferred Lifetime                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                           Reserved2                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+                                                               +
|                                                               |
+                            Prefix                             +
|                                                               |
+                                                               +
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

5. Security Considerations

At this time, no security considerations are addressed by this memo.

6. IANA Considerations

No request to IANA at this time.

7. Acknowledgements

The authors would like to thank (in alphabetical order) Michael Mathias Boc, Giorgio Campo, David Frey and Artiol Kalca for their valuable comments related to the Linux Network stack, the Legato OS recipies and the cross-compilation for the ARM architecture. Also the authors would like to acknowledge the contribution of Fred Baker and Michele Russo for valuable comments during the review of this memo.

8. Normative References

[ETSI102361]
ETSI, "ETSI TS 102 361-3 v1.1.7 (2007-12): Electromagnetic compatibility and Radio spectrum Matters; Digital Mobile Radio Systems; DRM data protocol.", April 2016.

[I-D.ietf-dhc-rfc3315bis]
Mrugalski, T., Siodelski, M., Volz, B., Yourtchenko, A., Richardson, M., Jiang, S., Lemon, T., and T. Winters, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6) bis", draft-ietf-dhc-rfc3315bis-13 (work in progress), April 2018.

[RFC1661] Simpson, W., Ed., "The Point-to-Point Protocol (PPP)", STD 51, RFC 1661, DOI 10.17487/RFC1661, July 1994, <https://www.rfc-editor.org/info/rfc1661>.

[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>.

[RFC3633] Troan, O. and R. Droms, "IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6", RFC 3633, DOI 10.17487/RFC3633, December 2003, <https://www.rfc-editor.org/info/rfc3633>.

[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>.

[RFC6459] Korhonen, J., Ed., Soininen, J., Patil, B., Savolainen, T., Bajko, G., and K. Iisakkila, "IPv6 in 3rd Generation Partnership Project (3GPP) Evolved Packet System (EPS)", RFC 6459, DOI 10.17487/RFC6459, January 2012, <https://www.rfc-editor.org/info/rfc6459>.

[RFC6653] Sarikaya, B., Xia, F., and T. Lemon, "DHCPv6 Prefix Delegation in Long-Term Evolution (LTE) Networks", RFC 6653, DOI 10.17487/RFC6653, July 2012,

<https://www.rfc-editor.org/info/rfc6653>.

[RFC8200] Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", STD 86, RFC 8200, DOI 10.17487/RFC8200, July 2017, <https://www.rfc-editor.org/info/rfc8200>.

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