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                DHCPv6 options for MQTT client configuration
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Abstract

   This document defines Dynamic Host Configuration Protocol and Dynamic
   Host Configuration Protocol version 6 (DHCPv6) Options for MQTT
   client configuration information, which are used to carry Uniform
   Resource Locater of MQTT broker and MQTT topic prefix that should be
   used as prefix for any topic published by MQTT client.

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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   material or to cite them other than as "work in progress."

   This Internet-Draft will expire on April 23, 2018.

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1. Introduction

   The Message Queue Telemetry Transport (MQTT) protocol is a light-
   weight IoT protocol, based on the publish/subscribe communication
   model. MQTT clients, that can be publishers or subscribers,
   communicate with each other via a broker. The broker hosts a set of
   "topics" and clients can publish and subscribe to these topics. All
   data published to a topic is delivered to all clients who are
   subscribed to the same topic. In communications network using MQTT
   clients commonly use a preconfigured address information, such as
   Uniform Resource Identifier (URI), to register with a MQTT broker.
   The URI might be configured by a user or an operator through a local
   device interface. Alternatively, the URI might be provided as a
   hardcoded value by manufacturer of the MQTT client device.

   Hard coding configuration by device manufacturer forces device
   operator to use same configuration as hard coded. It is possible
   that reachability information of MQTT broker that is hard coded may
   be outdated and MQTT broker reachability might fail during first use
   of device. In such cases connectivity with MQTT broker is possible
   only through device software upgrade.

   Subscribers who are interested in specific data of a specific topic
   registers the topic with the MQTT broker. MQTT clients acting as
   publishers register/create topics, and MQTT clients acting as
   subscribers register for a specific existing topic. In general

terms, a topic can represented by a hierarchical string defined by
MQTT service or device operator. Before operation every MQTT client
that wishes to publish data on a specific topic should be aware of
the corresponding hierarchical strings that are supposed to be used
for the topics for the MQTT client to publish topic specific data.

However, uniqueness of topics in the MQTT network is not guaranteed
as there is no standard guideline that guarantees uniqueness. In the
same MQTT network, using the same MQTT broker, different MQTT clients
can accidentally use the same topic to publish data, which results in
invalid operation. In such scenarios, subscribers might receive
wrong data and publishers may change data they were not supposed to
change. Network or device operators therefore have to take care of
the topic name space across the MQTT network so that topic identities
are unique across the MQTT network. This manual operation is error-
prone and costly.

This draft propose DHCP and DHCPv6 options to dynamically configure
MQTT client with MQTT broker URI and one or more topic prefixs to
guarantee uniqueness of topic used across MQTT network.

2. MQTT client configuration through DHCP

MQTT broker URI and topic prefix can be collected during dynamic host
configuration phase. DHCPv4 and DHCPv6 options can be extended to
collect MQTT broker URI and MQTT topic prefix for IPv4 and IPv6
networks respectively. DHCPv4 or DHCPv6 client requests MQTT broker
URI and MQTT topic prefix using new options proposed in sections
below

2.1. DHCPv6 option for MQTT broker URI

DHCPv6 option OPTION_MQTT_BROKER_URI conveys URI through which MQTT
client can reach MQTT broker in IPv6 network. The format of MQTT
broker URI option is as shown 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     option-code               |         option-len            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        MQTT-broker-URI                        |
|                     (variable length data)                   |
|                              ...                             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```


option-code: OPTION_MQTT_BROKER_URI

   option-len: Length of the 'MQTT-broker-URI' field in octets

   MQTT-broker-URI: This string is URI of MQTT broker. The string is
      not null-terminated.

2.2. DHCPv6 option for MQTT topic prefix

   DHCPv6 option OPTION_MQTT_TOPIC_PREFIX conveys prefix string which
   can be used by MQTT client as prefix of each topic used for
   publishing data. The format of MQTT topic prefix option is as shown
   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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          option-code          |          option-len           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
|                      MQTT-topic-prefix                        |
|                    (variable length data)                     |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   option-code: OPTION_MQTT_TOPIC_PREFIX

   option-len: Length of the 'MQTT-topic-prefix' field in octets

   MQTT-topic-prefix: MQTT topic prefix string that can be used by MQTT
      client as prefix to each topic used for publishing data

2.3. DHCPv4 option for MQTT broker URI

   DHCPv4 option OPTION_MQTT_BROKER_URI conveys URI through which MQTT
   client can reach MQTT broker that is reachable through IPv4 network.
   The format of MQTT broker URI option is as shown 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| option-code  |  option-len   |                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               +
|                                                               |
|            MQTT-broker-URI(variable length data)              |
|                              ...                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
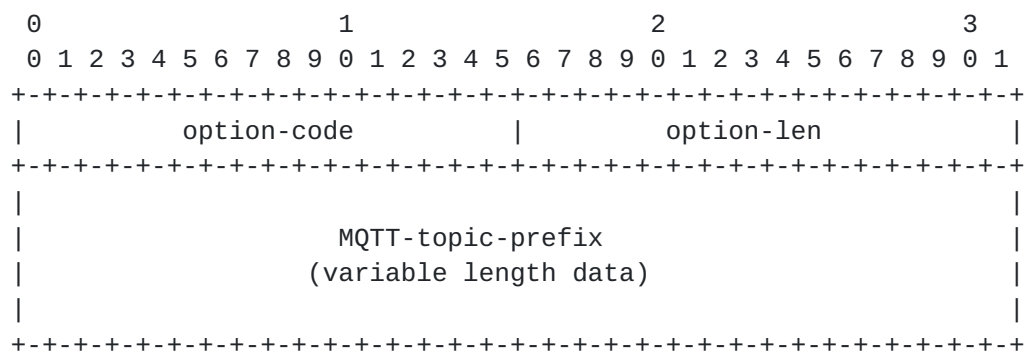
   option-code: OPTION_MQTT_BROKER_URI

   option-len: Length of the 'MQTT-broker-URI' field in octets

   MQTT-broker-URI: This string is URI of MQTT broker. The string is
      not null-terminated.

2.4. DHCPv4 option for MQTT topic prefix

   DHCPv4 option OPTION_MQTT_TOPIC_PREFIX conveys prefix string which
   can be used by MQTT client as prefix of each topic used for
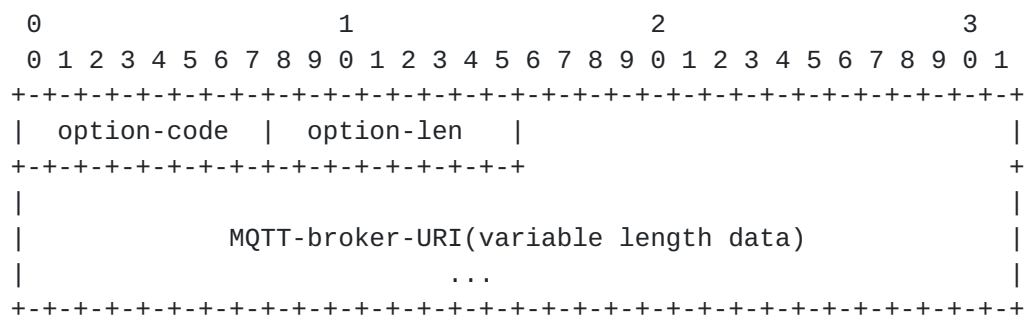   publishing data. The format of MQTT topic prefix option is as shown
   below:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  option-code  |   option-len  |                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               +
|                                                               |
|                       MQTT-topic-prefix                       |
|                      (variable length data)                   |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   option-code: OPTION_MQTT_TOPIC_PREFIX

   option-len: Length of the 'MQTT-topic-prefix' field in octets

   MQTT-topic-prefix: MQTT topic prefix string that can be used by MQTT
      client as prefix to each topic used for publishing data

3. Appearance of Option

3.1. Appearance of options in DHCPv6 control messages

   The OPTION_MQTT_BROKER_URI and OPTION_MQTT_TOPIC_PREFIX options MUST
   NOT appear in messages other than the following: SOLICIT (1),
   ADVERTISE (2), REQUEST (3),REPLY (4) RENEW (5), REBIND (6),
   INFORMATION-REQUEST (11). If this option appears in messages other
   than those specified above, the receiver MUST ignore it.

   The option number for OPTION_MQTT_BROKER_URI and
   OPTION_MQTT_TOPIC_PREFIX options MAY appear in the "Option Request"
   option [RFC3315] in the following messages: SOLICIT (1), REQUEST (3),
   RENEW (5), REBIND (6), INFORMATION-REQUEST (11) and RECONFIGURE (10).
   If this option number appears in the "Option Request" option in
   messages other than those specified above, the receiver SHOULD ignore
   it.

3.2. Appearance of options in DHCPv4 control messages

The OPTION_MQTT_BROKER_URI and OPTION_MQTT_TOPIC_PREFIX options MUST
NOT appear in messages other than the following: DHCPDISCOVER (1),
DHCPOFFER (2), DHCPREQUEST (3), DHCPACK (5) and DHCPINFORM (8). If
this option appears in messages other than those specified above, the
receiver MUST ignore it.

The option number for OPTION_MQTT_BROKER_URI and
OPTION_MQTT_TOPIC_PREFIX options MAY appear in the "Parameter Request
List" option [RFC2132] in the following messages: DHCPDISCOVER (1),
DHCPOFFER (2), DHCPREQUEST (3), DHCPACK (5) and DHCPINFORM (8). If
this option number appears in the "Parameter Request List" option in
messages other than those specified above, the receiver SHOULD ignore
it.

Maximum possible value of DHCPv4 "option-len" is 255. MQTT-topic-
prefix MAY be of length more than 255. To accommodate larger
certificate, DHCP server SHOULD follow encoding as mentioned in
[RFC3396].

4. Configuration Guidelines for the Server

DHCPv4 or DHCPv6 server that supports OPTION_MQTT_BROKER_URI and
OPTION_MQTT_TOPIC_PREFIX SHOULD be configured with one or more MQTT
broker URI, and one or moretopic prefix for each MQTT client. DHCP
server may use statically configured topic prefixes or algorithem
genrated topic prefixes. Algorithems to generate MQTT topic prefix
for an MQTT client might use client attributes like data link layer
address. Details of algorithems to generate topic prefix and
guidelines to manage topic prefixes are not included in the scope of
this draft

In the absence of MQTT broker URI configuration, DHCP server SHOULD
ignore option OPTION_MQTT_BROKER_URI, and SHOULD continue processing
of DHCP control message

In the absence of MQTT topic prefix configuration and topic prefix
generation algorithem, DHCP server SHOULD ignore option
OPTION_MQTT_TOPIC_PREFIX, and SHOULD continue processing of DHCP
control message

5. DHCPv4/DHCPv6 Client Behavior

DHCP or DHCPv6 client MAY decide need for inclusion of
OPTION_MQTT_BROKER_URI and OPTION_MQTT_TOPIC_PREFIX options in DHCPv4
or DHCPv6 control messages if device is capable of supporting MQTT
client functionality irrespective of state of MQTT client. It is

possible that MQTT client MAY not be active before DHCPv4 or DHCPv6
message exchanges happens. In such scenario, DHCPv4 or DHCPv6 client
MAY collect MQTT broker URI and MQTT topic prefix and keep ready for
MQTT client initialization

DHCPv4 or DHCPv6 client MAY prefer collecting MQTT broker URI and
MQTT topic prefix by including OPTION_MQTT_BROKER_URI and
OPTION_MQTT_TOPIC_PREFIX options in DHCPINFORM or INFORMATION-REQUEST
message which MAY be send during MQTT client initialization

MQTT client devices running with IPv6 stack MAY use stateless auto
address configuration to get IPv6 address. Such clients MAY use
DHCPv6 INFORMATION-REQUEST to get MQTT broker URI and MQTT topic
prefix through options OPTION_MQTT_BROKER_URI and
OPTION_MQTT_TOPIC_PREFIX

6. Relay agent Behavior

This draft does not impose any new requirements on DHCPv4 or DHCPv6
relay agent functionality

7. Security Considerations

OPTION_MQTT_BROKER_URI option could be used by an intruder to
advertise the URI of a malicious MQTT broker which results in data
reporting by MQTT clients to an unwanted MQTT broker. As an example,
an attacker could collect data from secure locations by deploying
malicious servers.

Intuders might use OPTION_MQTT_TOPIC_PREFIX option to advertise
unwanted topic prefixes which results in duplicate MQTT topics As an
example, an attacker could collect data from secure locations by
deploying malicious servers.

To prevent these attacks, it is strongly advisable to secure the use
of these options by either:

o Using authenticated DHCP as described in [RFC3315], Section 21.

o Using options OPTION_MQTT_BROKER_URI and OPTION_MQTT_TOPIC_PREFIX
   only with trusted DHCP server

The security considerations documented in [RFC3315] are to be
considered.

8. Acknowledgement

   Particular thanks to A. Keraenen and S. Krishnan for inputs and
   review.

9. IANA Considerations

   IANA is requested to assign new DHCPv6 option codes in the registry
   maintained in http://www.iana.org/assignments/dhcpv6-parameters:

```
            |        Option Name              |   Value |
            |---------------------------------+---------|
            | OPTION_MQTT_BROKER_URI          |    TBA  |
            | OPTION_MQTT_TOPIC_PREFIX         |    TBA  |
```

   IANA is requested to assign new DHCPv4 option codes in the registry
   maintained in http://www.iana.org/assignments/bootp-dhcp-parameters:

```
            |        Option Name              |  Value |
            |---------------------------------+--------|
            | OPTION_MQTT_BROKER_URI          |   TBA  |
            | OPTION_MQTT_TOPIC_PREFIX         |   TBA  |
```

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