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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 Locator of MQTT broker and MQTT topic prefix that should be used as prefix for any topic published by MQTT client.

Status of This Memo

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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 It is possible that reachability information of MQTT broker that is hard coded may be outdated and MQTT broker reachability might fail during first use of device.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 be 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.

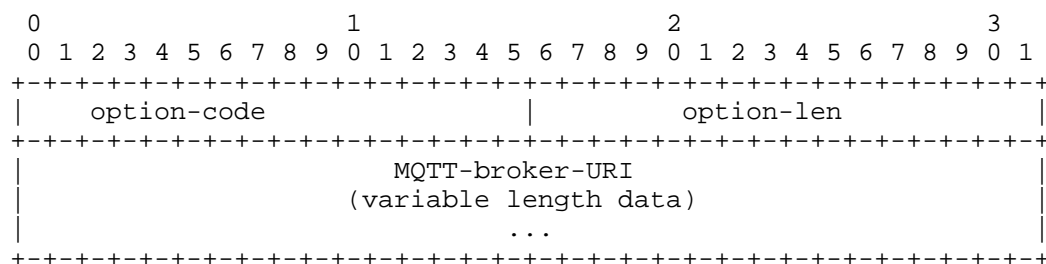
This draft proposes DHCP and DHCPv6 options to dynamically configure MQTT client with MQTT broker URI and one or more topic prefixes to guarantee uniqueness of topic used across MQTT network.

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:



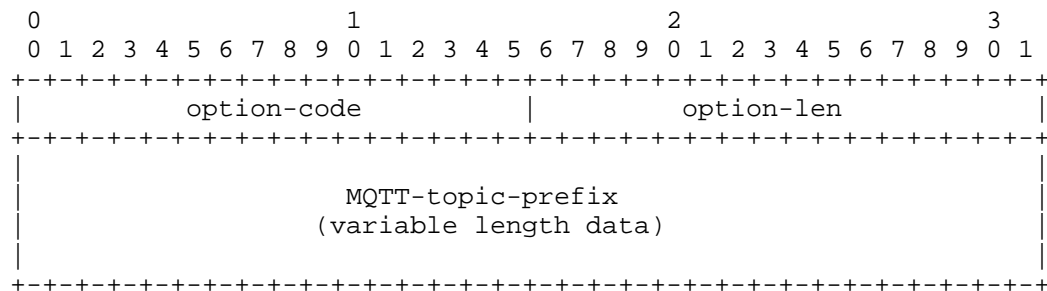
option-code: `OPTION_MQTT_BROKER_URI`

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:



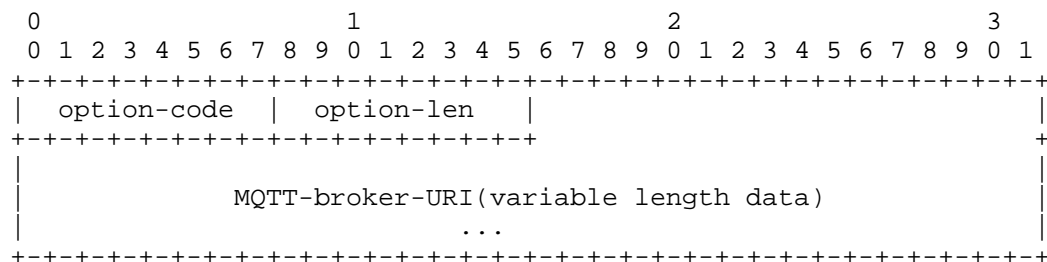
option-code: `OPTION_MQTT_TOPIC_PREFIX`

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:



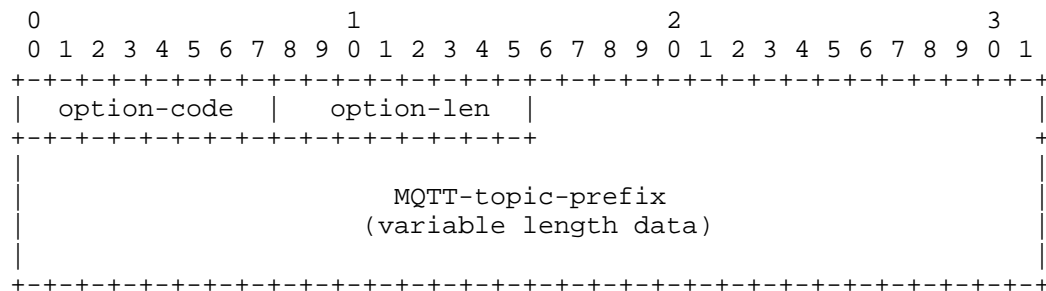
option-code: `OPTION_MQTT_BROKER_URI`

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:



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 more topic prefix for each MQTT client. DHCP server may use statically configured topic prefixes or algorithm generated topic prefixes. Algorithms to generate MQTT topic prefix for an MQTT client might use client attributes like data link layer address. Details of algorithms 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 algorithm, 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

10. References

10.1. Normative References

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10.2. Informative References

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