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**DHCPv6 Options for LWM2M bootstrap information**  
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Abstract

This document defines Dynamic Host Configuration Protocol and Dynamic Host Configuration Protocol version 6 (DHCPv6) Options for LWM2M client bootstrap information, which are used to carry Uniform Resource Locator of LWM2M bootstrap server and certificate that validates the public key presented by server.

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## [1.](#) Introduction

Light weight machine to machine (LWM2M) protocol is used to manage end device life cycle in machine to machine communication scenarios. LWM2M device bootstrap is an optional life cycle phase for devices to get needed information when starting up for first time. Information gathered during bootstrapping might include management server details and security certificates required to establish connectivity with management server. Information required to connect with bootstrap server might be hard coded during device manufacturing phase.

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 It is possible that reachability information of bootstrap server that is hard coded may be outdated and boot strap server reachability might fail during first use of device.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

## [2.](#) Terminology

This document makes use of the following terms:

LWM2M: Lightweight Machine to Machine is a protocol from Open Mobile alliance for device management in M2M or Internet of Things scenarios



**LWM2M bootstrap server:** The server that provides LWM2M bootstrap interface which is used to optionally configure a LWM2M Client so that it can successfully register with a LWM2M management Server

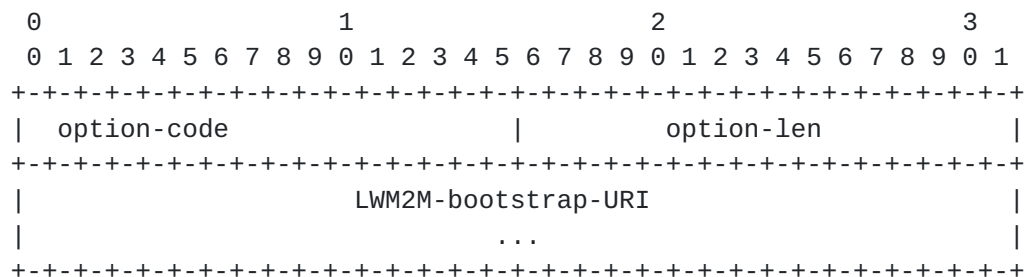
**LWM2M management server:** The server that provides registration, device management and service enablement interface to manage a LWM2M client.

### **3. LWM2M bootstrap server information through DHC**

LWM2M bootstrap server details like URI and security certificate can be collected during dynamic host configuration phase. DHCP and DHCPv6 options can be extended to collect LWM2M bootstrap server information for IPv4 and IPv6 networks respectively. DHCP or DHCPv6 client requests LWM2M bootstrap server URI and LWM2M server certificate using new options proposed in sections below

#### **3.1. DHCPv6 option for LWM2M bootstrap server URI**

DHCPv6 option `OPTION_LWM2M_BOOTSTRAP_URI` conveys URI through which LWM2M client can reach LWM2M bootstrap server reachable through IPv6 network. The format of LWM2M bootstrap server URI option is as shown below:



option-code: `OPTION_LWM2M_BOOTSTRAP_URI`

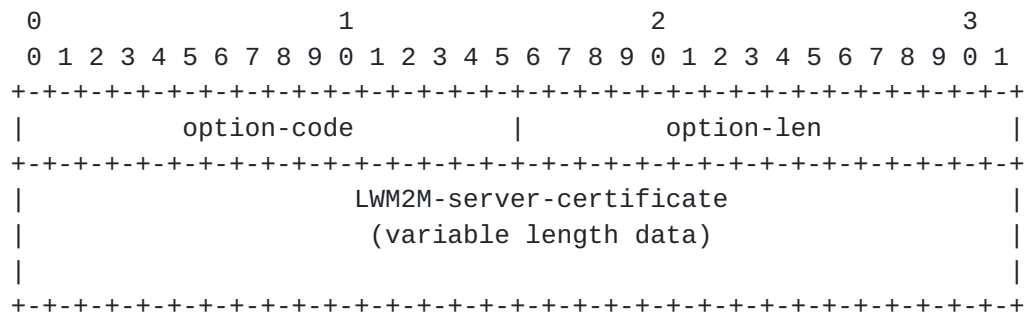
option-len: Length of the 'LWM2M-bootstrap-URI' field in octets

LWM2M-bootstrap-URI: This string is URI of LWM2M bootstrap server. The string is not null-terminated.

#### **3.2. DHCPv6 option for LWM2M server certificate**

DHCPv6 option `OPTION_LWM2M_SERVER_CERTIFICATE` conveys security certificate which can be used by LWM2M client to establish secure connection with LWM2M server reachable through IPv6 network. The format of LWM2M server certificate option is as shown below:





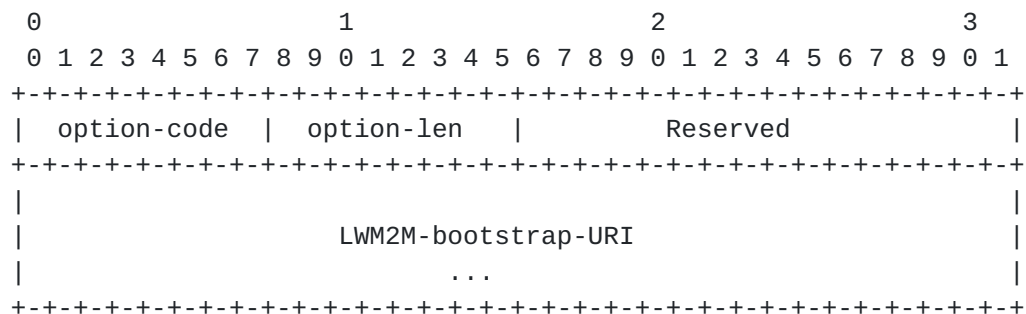
option-code: OPTION\_LWM2M\_SERVER\_CERTIFICATE

option-len: Length of the 'LWM2M-server-certificate' field in octets

LWM2M-server-certificate: Digital certificate of LWM2M server as defined in [Section 3.6 of \[RFC7296\]](#)

### 3.3. DHCP option for LWM2M bootstrap server URI

DHCP option OPTION\_LWM2M\_BOOTSTRAP\_URI conveys URI through which LWM2M client can reach LWM2M bootstrap server reachable through IPv4 network. The format of LWM2M bootstrap server URI option is as shown below:



option-code: OPTION\_LWM2M\_BOOTSTRAP\_URI

option-len: Length of the 'LWM2M-bootstrap-URI' field in octets

Reserved: MUST be set to zero

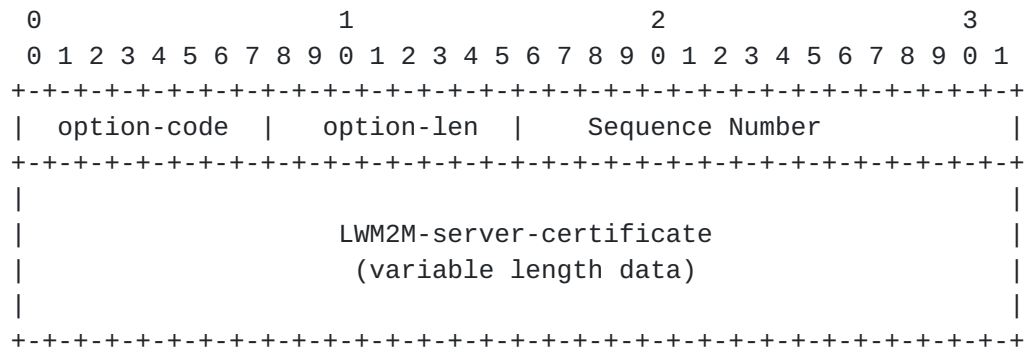
LWM2M-bootstrap-URI: This string is URI of LWM2M bootstrap server. The string is not null-terminated.

### 3.4. DHCP option for LWM2M server certificate

DHCP option OPTION\_LWM2M\_SERVER\_CERTIFICATE conveys security certificate which can be used by LWM2M client to establish secure



connection with LWM2M server reachable through IPv4 network. The format of LWM2M server certificate option is as shown below:



option-code: OPTION\_LWM2M\_SERVER\_CERTIFICATE

option-len: Length of the 'LWM2M-server-certificate' field in octets

Sequence Number: Sequence number of OPTION\_LWM2M\_SERVER\_CERTIFICATE in the scope of DHCP packet. Sequence number starts with zero and incremented by 1 for every new OPTION\_LWM2M\_SERVER\_CERTIFICATE option added to DHCP packet

LWM2M-server-certificate: Digital certificate of LWM2M server as defined in [Section 3.6 of \[RFC7296\]](#)

## 4. Appearance of Option

### 4.1. Appearance of options in DHCPv6 control messages

The OPTION\_LWM2M\_BOOTSTRAP\_URI and OPTION\_LWM2M\_SERVER\_CERTIFICATE 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\_LWM2M\_BOOTSTRAP\_URI and OPTION\_LWM2M\_SERVER\_CERTIFICATE 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.





#### **4.2. Appearance of options in DHCP control messages**

The `OPTION_LWM2M_BOOTSTRAP_URI` and `OPTION_LWM2M_SERVER_CERTIFICATE` 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_LWM2M_BOOTSTRAP_URI` and `OPTION_LWM2M_SERVER_CERTIFICATE` 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 DHCP "option-len" is 255. LWM2M-server-certificate MAY be of length more than 255. To accommodate larger certificate, it SHOULD be possible to include multiple `OPTION_LWM2M_SERVER_CERTIFICATE` options in same DHCP message. DHCP server SHOULD be capable of including multiple `OPTION_LWM2M_SERVER_CERTIFICATE` options in same message. Certificates larger than 255 byte SHOULD be fragmented and adjusted in minimum possible number of `OPTION_LWM2M_SERVER_CERTIFICATE` options. Each `OPTION_LWM2M_SERVER_CERTIFICATE` option is tagged with a sequence number which can be used by DHCP client to reassemble received certificate

#### **5. Configuration Guidelines for the Server**

DHCP or DHCPv6 server that supports `OPTION_LWM2M_BOOTSTRAP_URI` and `OPTION_LWM2M_SERVER_CERTIFICATE` SHOULD be configured with one and only one LWM2M bootstrap server URI, and one and only one certificate that validates bootstrap server's public key.

In the absence of URI configuration, DHCP server SHOULD ignore option `OPTION_LWM2M_BOOTSTRAP_URI`, and SHOULD continue processing of DHCP control message

In the absence of certificate configuration, DHCP server SHOULD ignore option `OPTION_LWM2M_SERVER_CERTIFICATE`, and SHOULD continue processing of DHCP control message

#### **6. DHCP/DHCPv6 Client Behavior**

DHCP or DHCPv6 client MAY decide need for inclusion of `OPTION_LWM2M_BOOTSTRAP_URI` and `OPTION_LWM2M_SERVER_CERTIFICATE` options in DHCP or DHCPv6 control messages if device is capable of



supporting LWM2M client functionality irrespective of state of LWM2M client. It is possible that LWM2M client MAY not be active before DHCP or DHCPv6 message exchanges happens. In such scenario, DHCP or DHCPv6 client MAY collect LWM2M bootstrap server URI and LWM2M server certificate and keep ready for LWM2M client initialization

DHCP or DHCPv6 client MAY prefer collecting LWM2M bootstrap server URI and LWM2M server certificate by including `OPTION_LWM2M_BOOTSTRAP_URI` and `OPTION_LWM2M_SERVER_CERTIFICATE` options in `DHCPINFORM` or `INFORMATION-REQUEST` message which MAY be send during LWM2M client initialization

LWM2M 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 LWM2M bootstrap URI and LWM2M server server certificate through options `OPTION_LWM2M_BOOTSTRAP_URI` and `OPTION_LWM2M_SERVER_CERTIFICATE`

## **7. Relay agent Behavior**

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

## **8. Security Considerations**

`OPTION_LWM2M_BOOTSTRAP_URI` and `OPTION_LWM2M_SERVER_CERTIFICAT` options could be used by an intruder to advertise the URI of a malicious LWM2M bootstrap server and certificate and can alter the LWM2M management server details provided to LWM2M client. The consequences of such an attack can be critical, because any data that is reported by LWM2M client MAY reach unwanted LWM2M management server. 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 this option by either:

- o Using authenticated DHCP as described in [\[RFC3315\]](#), [Section 21](#).
- o Using options `OPTION_LWM2M_BOOTSTRAP_URI` and `OPTION_LWM2M_SERVER_CERTIFICATE` only with trusted DHCP server

The security considerations documented in [\[RFC3315\]](#) are to be considered.



## 9. Acknowledgement

Particular thanks to A. Keraenen, J. Jimenez, J. Melen and S. Krishnan for the concept, inputs and review.

## 10. 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_LWM2M_BOOTSTRAP_URI	TBA
OPTION_LWM2M_SERVER_CERTIFICATE	TBA

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

Option Name	Value
OPTION_LWM2M_BOOTSTRAP_URI	TBA
OPTION_LWM2M_SERVER_CERTIFICATE	TBA

## 11. Normative References

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- [RFC7227] Hankins, D., Mrugalski, T., Siodelski, M., Jiang, S., and S. Krishnan, "Guidelines for Creating New DHCPv6 Options", [BCP 187](#), [RFC 7227](#), DOI 10.17487/RFC7227, May 2014, <<http://www.rfc-editor.org/info/rfc7227>>.
- [RFC7296] Kaufman, C., Hoffman, P., Nir, Y., Eronen, P., and T. Kivinen, "Internet Key Exchange Protocol Version 2 (IKEv2)", STD 79, [RFC 7296](#), DOI 10.17487/RFC7296, October 2014, <<http://www.rfc-editor.org/info/rfc7296>>.

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