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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 Locater of LWM2M bootstrap server and certificate that validates the public key presented by server.

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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This Internet-Draft will expire on March 1, 2018.

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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 It is possible that reachability information of bootstrap server that is hard coded may be outdated and boot strap server reachability might fail during first use of device.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

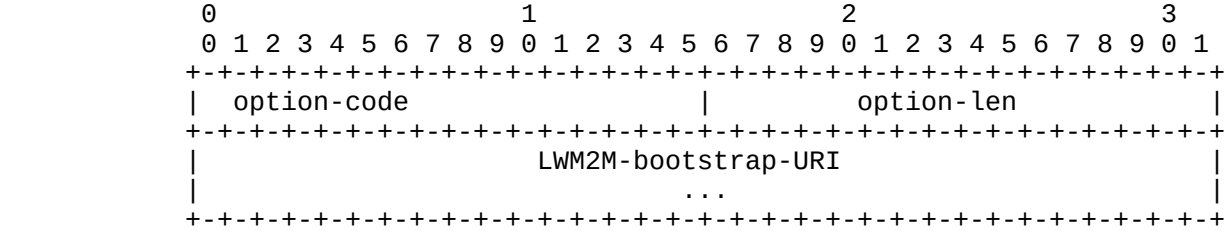
LWM2M management server: The server that provides registration, device management and service enablement interface to manage a LWM2M client.

3. LWM2M bootstrap server information through DHC

LWM2M bootstrap server details like URI and security certificate can be collected during dynamic host configuration phase. DHCPv4 and DHCPv6 options can be extended to collect LWM2M bootstrap server information for IPv4 and IPv6 networks respectively. DHCPv4 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:



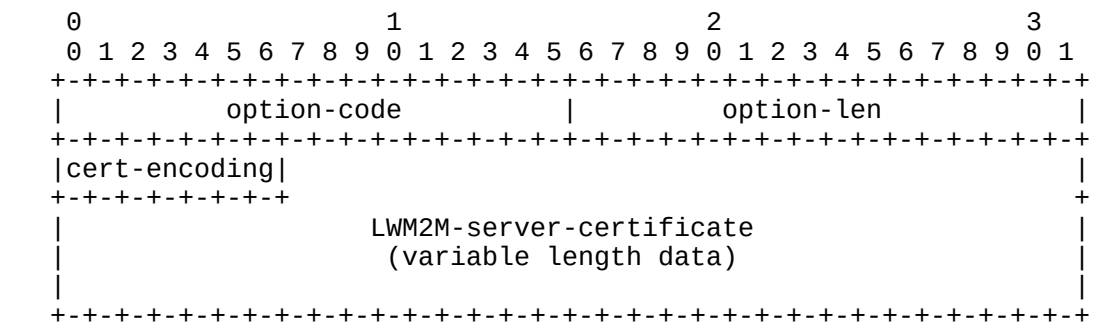
option-code: OPTION_LWM2M_BOOTSTRAP_URI

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

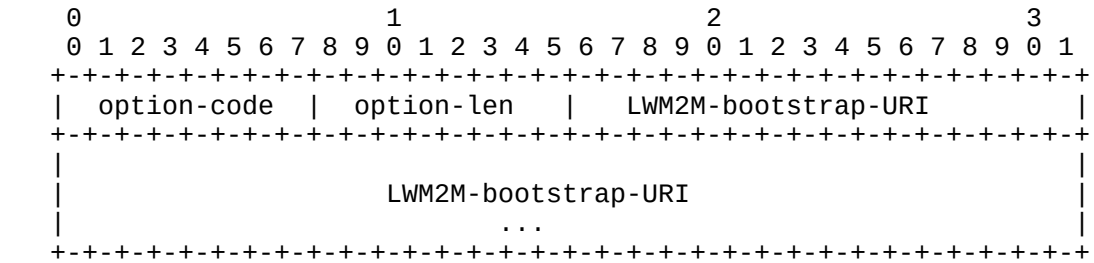
option-len: Length of the 'LWM2M-server-certificate' field in octets + 1

cert-encoding: This field indicates the type of certificate or certificate-related information contained in LWM2M-server-certificate field. See Section 4 for details.

LWM2M-server-certificate: Digital certificate of LWM2M server encoded according to cert-encoding. See Section 4 for details

3.3. DHCPv4 option for LWM2M bootstrap server URI

DHCPv4 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:



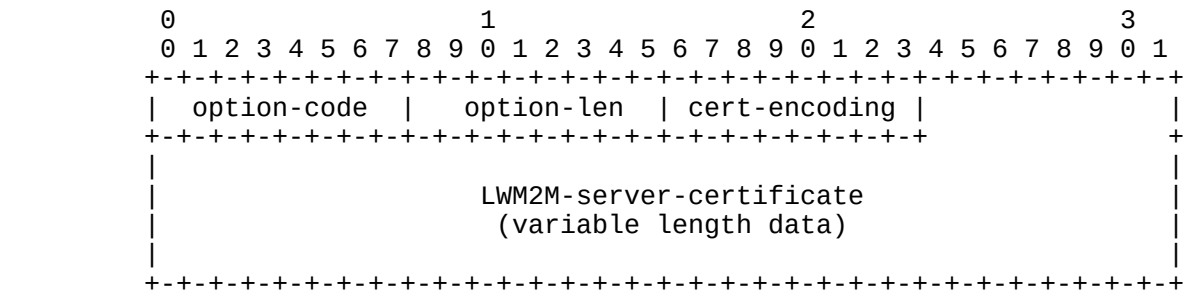
option-code: OPTION_LWM2M_BOOTSTRAP_URI

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

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

3.4. DHCPv4 option for LWM2M server certificate

DHCPv4 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 + 1

cert-encoding: This field indicates the type of certificate or certificate-related information contained in LWM2M-server-certificate field. See Section 4 for details.

LWM2M-server-certificate: Digital certificate of LWM2M server encoded according to cert-encoding. See Section 4 for details

4. LWM2M-server-certificate encoding

As defined in Section 3.6 of [RFC7296] and [IKEv2IANA] the values in the following table are allocated for Certificate Encoding types. Other values may have been added since then or will be added after the publication of this document. Readers should refer to [IKEv2IANA] for latest values.

Value	Certificate Encoding
0	Reserved
1	PKCS #7 wrapped X.509 certificate
2	PGP Certificate
3	DNS Signed Key
4	X.509 Certificate - Signature
5	Reserved
6	Kerberos Token
7	Certificate Revocation List (CRL)
8	Authority Revocation List (ARL)
9	SPKI Certificate
10	X.509 Certificate - Attribute
11	Raw RSA Key (DEPRECATED)
12	Hash and URL of X.509 certificate
13	Hash and URL of X.509 bundle
14	OCSP Content
15	Raw Public Key
16-200	Unassigned
201-255	Private use

5. Appearance of Option

5.1. 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.

5.2. Appearance of options in DHCPv4 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 DHCPv4 "option-len" is 255. LWM2M-server-certificate MAY be of length more than 255. To accommodate larger certificate, DHCP server SHOULD follow encoding as mentioned in [RFC3396].

6. Configuration Guidelines for the Server

DHCPv4 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

7. DHCPv4/DHCPv6 Client Behavior

DHCP or DHCPv6 client MAY decide need for inclusion of OPTION_LWM2M_BOOTSTRAP_URI and OPTION_LWM2M_SERVER_CERTIFICATE options in DHCPv4 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 DHCPv4 or DHCPv6 message exchanges happens. In such scenario, DHCPv4 or DHCPv6 client MAY collect LWM2M bootstrap server URI and LWM2M server certificate and keep ready for LWM2M client initialization

DHCPv4 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

8. Relay agent Behavior

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

9. 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:

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

10. Acknowledgement

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

11. 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 DHCPv4 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

12. References

12.1. Normative References

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[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, <https://www.rfc-editor.org/info/rfc7296>.

12.2. Informative References

[IKEv2IANA] "Internet Key Exchange Version 2 (IKEv2) Parameters", n.d., <https://www.iana.org/assignments/ikev2-parameters/ikev2-parameters.xhtml>.

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