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MPL Parameter Configuration Option for DHCPv6
draft-ietf-roll-mpl-parameter-configuration-05

Abstract

This document defines a way to configure a parameter set for MPL (Multicast Protocol for Low power and Lossy Networks) via a DHCPv6 option. MPL has a set of parameters to control its behavior, and the parameter set is often configured as a network-wide parameter because the parameter set should be identical for each MPL forwarder in an MPL domain. Using the MPL Parameter Configuration Option defined in this document, a network can be configured with a single set of MPL parameters easily.

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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1. Introduction

Multicast Protocol for Low power and Lossy Networks (MPL) [I-D.ietf-roll-trickle-mcast] defines a protocol to make a multicast network among low-power and lossy networks, e.g., wireless mesh networks. MPL has a set of parameters to control an MPL domain. The parameters control the trade-off between end-to-end delay and network utilization. In most environments, the default parameters are acceptable. However, in some environments, the parameter set must be configured carefully in order to meet the requirements of each environment. According to the MPL document section 5.4, each parameter in the set should be the same for all nodes within an MPL domain, but the MPL document does not define a method to configure the MPL parameter set.

Some managed wireless mesh networks may have a DHCP server to configure network parameters. MPL parameter sets shall be considered as a part of network parameters (nodes in an MPL domain should use an identical parameter set). And a parameter set is required to

configure an MPL domain.

This document defines the way to distribute parameter sets for MPL forwarders as a DHCPv6 [RFC3315] option. This document is intended to follow [RFC7227] the guideline.

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 [RFC2119].

2. MPL Parameter Configuration Option

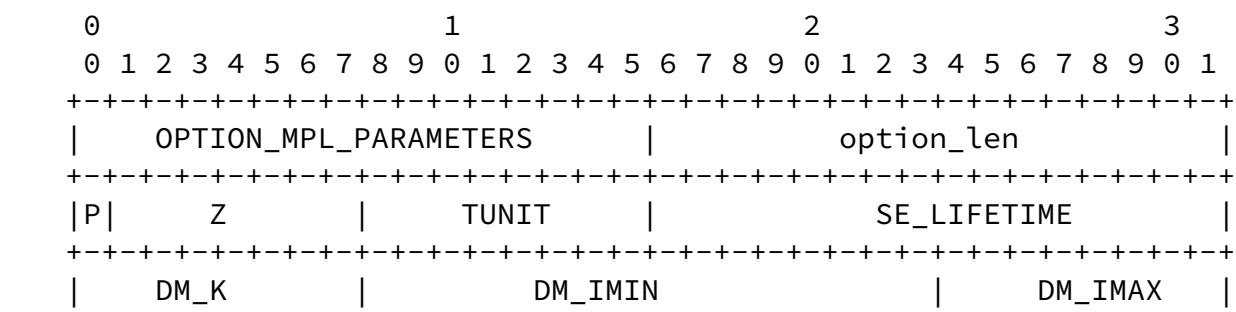
Per MPL domain, there are the following 10 parameters. An MPL domain is defined by an MPL domain address.

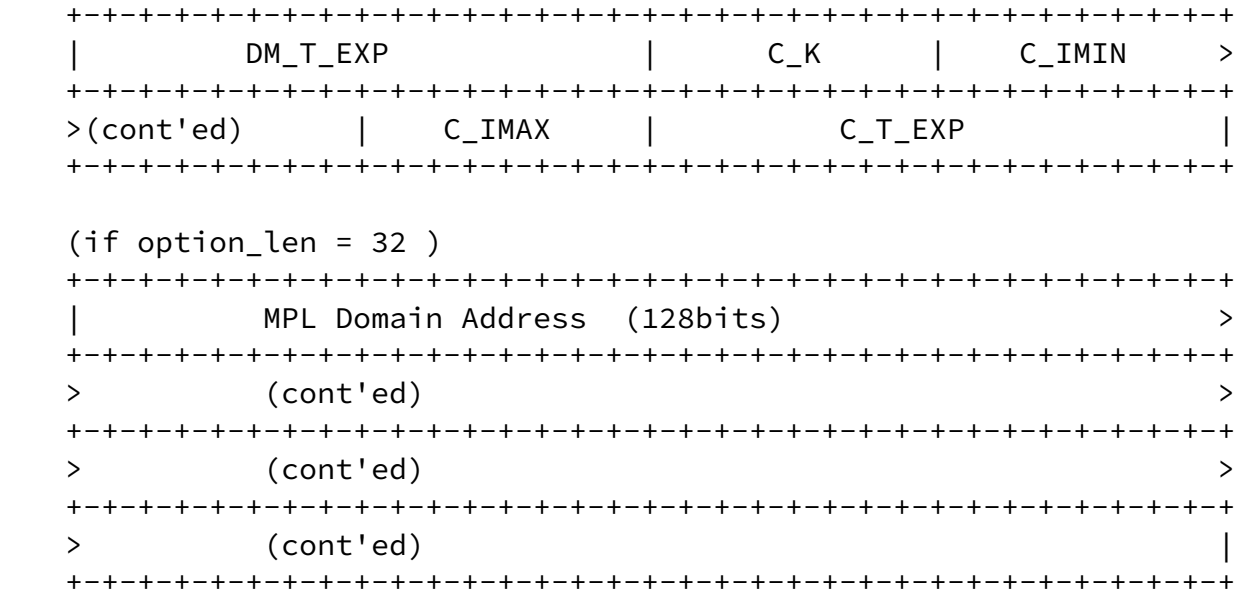
- PROACTIVE_FORWARDING
- SEED_SET_ENTRY_LIFETIME
- DATA_MESSAGE_IMIN
- DATA_MESSAGE_IMAX
- DATA_MESSAGE_K
- DATA_MESSAGE_TIMER_EXPIRATIONS
- CONTROL_MESSAGE_IMIN
- CONTROL_MESSAGE_IMAX
- CONTROL_MESSAGE_K
- CONTROL_MESSAGE_TIMER_EXPIRATIONS

One network may have multiple MPL domains with different configurations. To configure more than one MPL domain via DHCP, there may be more than one MPL Parameter Configuration Option given to DHCP clients by a DHCP server.

2.1. MPL Parameter Configuration Option Format

To distribute a configuration of an MPL domain or a default value for all MPL domains (wildcard) under the network managed by the DHCP server, this document defines a DHCPv6 option format as follows.





OPTION_MPL_PARAMETERS: DHCPv6 option identifier (not yet assigned).

option_len: Length of the option. It SHOULD be 16 (without MPL domain address) or 32 (with MPL domain address).

P (1 bit): A flag to indicate PROACTIVE_FORWARDING. The flag is set if PROACTIVE_FORWARDING is true.

Z (7 bits): Reserved. Should be 0.

TUNIT (unsigned 8-bit integer): Unit time of timer parameters (SE_LIFETIME, and *_IMIN) in this option. 0 and 0xff are reserved

and SHALL NOT be used.

SE_LIFETIME (unsigned 16-bit integer): SEED_SET_ENTRY_LIFETIME/TUNIT in milliseconds. 0 and 0xffff are reserved and SHALL NOT be used.

DM_K (unsigned 8-bit integer): DATA_MESSAGE_K.

DM_IMIN (unsigned 16-bit integer): DATA_MESSAGE_IMIN/TUNIT in milliseconds. 0 and 0xffff are reserved and SHALL NOT be used.

DM_IMAX (unsigned 8-bit integer): DATA_MESSAGE_IMAX. 0 and 0xff are reserved and SHALL NOT be used.

DM_T_EXP (unsigned 16-bit integer): DATA_MESSAGE_TIMER_EXPIRATIONS. 0 and 0xffff are reserved and SHALL NOT be used.

C_K (unsigned 8-bit integer): CONTROL_MESSAGE_K.

C_IMIN (unsigned 16-bit integer): CONTROL_MESSAGE_IMIN/TUNIT in milliseconds. 0 and 0xffff are reserved and SHALL NOT be used.

C_IMAX (unsigned 8-bit integer): CONTROL_MESSAGE_IMAX. 0 and 0xff are reserved and SHALL NOT be used.

C_T_EXP (unsigned 16-bit integer): CONTROL_MESSAGE_TIMER_EXPIRATIONS. 0 and 0xffff are reserved and SHALL NOT be used.

Note that all time values (Trickle timers and expiration periods) are in TUNIT milliseconds precision. For example, if TUNIT is 20 and the data message interval minimum (DATA_MESSAGE_IMIN) is 1000ms, then DM_IMIN shall be set to 50.

2.2. DHCPv6 Client Behavior

Clients MAY request the MPL Parameter Configuration Option, as described in [RFC3315], sections 17.1.1, 18.1.1, 18.1.3, 18.1.4, 18.1.5, and 22.7. As a convenience to the reader, we mention here that the client includes requested option codes in the Option Request Option.

Clients MUST discard the MPL Parameter Configuration Option if it is invalid (e.g., it sets reserved bits).

2.3. MPL Forwarder Behavior

If a DHCPv6 client requests and receives the MPL Parameter Configuration Option, the node SHOULD join the MPL domain given by the option and act as an MPL forwarder. Note that there may be cases in which a node may fail is to join a domain (or domains) due to local resource constraints. Each joining node SHOULD configure its MPL forwarder with the given parameter set for the MPL domain.

The priority of MPL Parameter Configurations applied to an MPL Domain is as follows (high to low):

- Specific MPL Parameter Configuration to the MPL Domain (option_len=32)
- Wildcard MPL Parameter Configuration (option_len=16)
- Default configuration given in the MPL specification.

There SHALL be no more than one MPL Parameter Configuration Option for an MPL domain or the wildcard. Thus, the order of DHCPv6 options in the packet has no effect on precedence.

A node MAY leave an MPL domain if the following two conditions are satisfied. 1) The MPL domain is configured by a DHCPv6 option from a DHCPv6 server previously. 2) The node has received an updated MPL Parameter Configuration Option without a configuration for the MPL domain.

MPL parameters may be updated occasionally. With stateful DHCPv6, updates can be done when the renewal timer expires. Information Refresh Time Option [RFC4242] shall be used to keep each forwarder updated.

To reduce periodic update traffic, a node may try to use a very long interval between updates. In the case, reconfigure messages may be used to keep forwarder parameter sets synchronized.

2.4. DHCPv6 Server Behavior

Sections 17.2.2 and 18.2 of [RFC3315] govern server operation in regards to option assignment. As a convenience to the reader, we mention here that the server will send the MPL Parameter Configuration Option only if it was configured with specific values for the MPL Parameter Configuration Option and the client requested it.

Servers SHALL ignore an incoming MPL Parameter Configuration Option.

2.5. DHCPv6 Relay Behavior

It's never appropriate for a relay agent to add options to a message heading toward the client, and relay agents don't actually construct Relay-Reply messages anyway. There are no additional requirements for relays.

2.6. Operational Considerations

A parameter set for an MPL domain SHOULD NOT be updated more often than twice of Information Refresh Time, even if the clients use longer Information Refresh Time to reduce DHCPv6 load on the network.

If a node with an MPL forwarder configured by the MPL Parameter Configuration Option failed to refresh the option within twice the Information Refresh Time, it SHALL suspend the MPL forwarders of the MPL domains configured by the option. MPL forwarders configured by other methods such as static configuration file SHALL NOT be suspended.

3. IANA Considerations

IANA is requested to assign one option code for OPTION_MPL_PARAMETERS from the "DHCP Option Codes" table of the Dynamic Host Configuration Protocol for IPv6 (DHCPv6) Registry.

4. Security Considerations

There are detailed discussion on security threats on DHCPv6 in Section 23 of RFC3315 [RFC3315] and Section 23 of RFC7227 [RFC7227].

In addition, a forged MPL parameter configuration may cause excessive layer-2 broadcasting. Implementations should set reasonable bounds for each parameter. For example, not too high DM/C_K, not too low DM /C_IMIN, etc. These bounds may be implementation dependent or may be derived from MAC/PHY specifications. DHCPv6 server and client implementations need to take care in setting reasonable bounds for each parameter in order to avoid overloading the network.

The DHCP server or the network itself should be trusted by some means such as DHCPv6 authentications described in Section 21 of RFC3315 [RFC3315]. However, ROLL environment may expect less computing resource, and DHCPv6 authentication may not available. In such cases, other methods for security should be applied to a ROLL network. Some ROLL specification such as ZigBee IP [ZigBeeIP] expects RFC5191 [RFC5191] to authenticate joining nodes and all nodes in the network can be trusted. To protect attacks from outside of the network, unneccessary DHCPv6 packets should be filtered on the border router between the ROLL network and the Internet.

5. References

5.1. Normative References

[I-D.ietf-roll-trickle-mcast]
Hui, J. and R. Kelsey, "Multicast Protocol for Low power and Lossy Networks (MPL)", draft-ietf-roll-trickle-mcast-12 (work in progress), June 2015.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC3315] Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C., and M. Carney, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)", RFC 3315, July 2003.

[RFC4242] Venaas, S., Chown, T., and B. Volz, "Information Refresh Time Option for Dynamic Host Configuration Protocol for IPv6 (DHCPv6)", RFC 4242, November 2005.

[RFC7227] Hankins, D., Mrugalski, T., Siodelski, M., Jiang, S., and

S. Krishnan, "Guidelines for Creating New DHCPv6 Options", BCP 187, RFC 7227, May 2014.

5.2. Informative References

[RFC5191] Forsberg, D., Ohba, Y., Patil, B., Tschofenig, H., and A. Yegin, "Protocol for Carrying Authentication for Network Access (PANA)", RFC 5191, May 2008.

[ZigBeeIP] ZigBee Alliance, "ZigBee IP Specification", Mar 2014.

Appendix A. Update History

Updates on draft-ietf-roll-mpl-configuration-03 to draft-ietf-roll-mpl-configuration-05:

- fixed *_IMAX definition as RFC6206 defines
- fixed *_EXP definition as draft-ietf-roll-trickle-mcast defines
- added references to RFC3315 and RFC7227 in security considerations section
- added a paragraph on security consideration according to secdir review
- fixed some nits and updated references

Updates on draft-ietf-roll-mpl-configuration-03 to draft-ietf-roll-mpl-configuration-04:

- References updated (Non-normative -> Informative)
- IANA section is updated to make clear request of option ID
- Reserved numbers are clearly denoted

Updates on draft-ietf-roll-mpl-configuration-02 to draft-ietf-roll-mpl-configuration-03:

- References updated
- Removed reference for DHCPv6 stateless reconfiguration as it has expired

Updates on draft-ietf-roll-mpl-configuration-01 to draft-ietf-roll-mpl-configuration-02:

- Short unsigned floating point is dropped (#159)
- Packed value is removed and now every value has its own byte(s) (#159)

Updates on draft-ietf-roll-mpl-configuration-00 to draft-ietf-roll-mpl-configuration-01:

- Operational considerations (normative) and appendix considerations (non-normative) are added (Issue #157)
- More control on nodes / allow constrained nodes to ignore the configuration: "the node s/SHOULD/MAY/ join the MPL domain given by the option" (Issue #158)

Updates on draft-doi-roll-mpl-configuration-05 to draft-ietf-roll-mpl-configuration-00:

- I-D renamed.

Appendix B. Considerations on Inconsistent Parameter Set

This draft introduces dynamic update of MPL parameters. Because the update process is not synchronized, nodes may have inconsistent parameter sets.

Inconsistent parameter set may reduce performance. On the other hand, this situation will work as long as both parameter sets are reasonable parameter sets for a given communication load. As the motivations for parameter update include update of the environment, node density, or communication load, operators of MPL networks shall be aware of unupdated nodes and make sure old and new parameter sets are reasonable for the expected refresh intervals.

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