

roll  
Internet-Draft  
Intended status: Standards Track  
Expires: September 8, 2016

P. van der Stok, Ed.  
consultant  
P. Thubert  
cisco  
March 7, 2016

**A YANG model for Multicast Protocol for Low power and lossy Networks  
(MPL)**  
**draft-vanderstok-core-mpl-yang-00**

#### Abstract

This document defines a YANG data model for management of Multicast Protocol for Low power and lossy Networks (MPL) implementations. The data model includes configuration data and state data.

#### Note

Discussion and suggestions for improvement are requested, and should be sent to [roll@ietf.org](mailto:roll@ietf.org).

#### Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of [BCP 78](#) and [BCP 79](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <http://datatracker.ietf.org/drafts/current/>.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on September 8, 2016.

#### Copyright Notice

Copyright (c) 2016 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](#) and the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents

carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

## Table of Contents

|   |    |
|---|----|
| <a href="#">1. Introduction</a>             | 2  |
| <a href="#">1.1. Terminology</a>            | 2  |
| <a href="#">1.1.1. Tree Diagrams</a>        | 3  |
| <a href="#">2. MPL model</a>                | 3  |
| <a href="#">3. ietf-yang-mpl module</a>     | 5  |
| <a href="#">4. IANA Considerations</a>      | 14 |
| <a href="#">5. Acknowledgements</a>         | 14 |
| <a href="#">6. Changelog</a>                | 14 |
| <a href="#">7. References</a>               | 14 |
| <a href="#">7.1. Normative References</a>   | 14 |
| <a href="#">7.2. Informative References</a> | 15 |
| <a href="#">Authors' Addresses</a>          | 15 |

## [1. Introduction](#)

This document defines a YANG [[RFC6020](#)] data model for management of Multicast Protocol for Low power and lossy Networks (MPL) [[RFC7731](#)] implementations. The data model covers configuration of per-interface MPL parameters. It also provides information about which Multicast addresses are operationally used, and the seeds for which packets are forwarded

### [1.1. Terminology](#)

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](#)].

The following terms are defined in [[RFC6241](#)] and are not redefined here:

- o client
- o configuration data
- o server
- o state data

van der Stok & Thubert Expires September 8, 2016

[Page 2]

The following terms are defined in [[RFC6020](#)] and are not redefined here:

- o augment
- o data model
- o data node

The terminology for describing YANG data models is found in [[RFC6020](#)].

Terms like domain, seed, I, k, c are defines in [[RFC7731](#)].

### [1.1.1. Tree Diagrams](#)

A simplified graphical representation of the data model is used in the YANG modules specified in this document. The meaning of the symbols in these diagrams is as follows:

Brackets "[" and "]" enclose list keys.

Abbreviations before data node names: "rw" means configuration data (read-write) and "ro" state data (read-only).

Symbols after data node names: "?" means an optional node, "!" means a presence container, and "\*" denotes a list and leaf-list.

Parentheses enclose choice and case nodes, and case nodes are also marked with a colon ":").

Ellipsis ("...") stands for contents of subtrees that are not shown.

## [2. MPL model](#)

This document defines the YANG module "ietf-yang-mpl", which specifies a data model for MPL servers. The model consists of the following parts: (1) a "mpl-domain" part that describes the MPL-domains and associated Multicast addresses and the interfaces on which the Multicast addresses are enabled, (2) a "mpl-op" part that describes the parameters settings per seed, (3) a "mpl-seeds" part that describes the MPL buffer contents and the Trickle timer values, and (4) a "mpl-statistics" part that describes the number of lost and correctly forwarded messages. The data model has the following structure for MPL configuration per node:

```
+--ro yang-mpl
```

van der Stok & Thubert Expires September 8, 2016

[Page 3]

```
+--rw mpl-domain
  +-rw domains* [domainID]
    +-rw domainID          uint16
    +-rw MClist*           yang:ipv6-address
  +-rw addresses* [MCaddress]
    +-rw MCaddress         yang:ipv6-address
    +-rw interfaces*      string
+-rw mpl-op
  +-rw SE_LIFETIME        uint16
  +-rw PROACTIVE_FORWARDING boolean
  +-rw SEED_SET_ENTRY_LIFETIME uint64
  +-rw mpl-parameter* [domainID]
    +-rw domainID          uint16
    +-rw DATA_MESSAGE_IMIN   uint16
    +-rw DATA_MESSAGE_IMAX   uint16
    +-rw DATA_MESSAGE_K      uint16
    +-rw DATA_MESSAGE_TIMER_EXPIRATIONS uint16
    +-rw CONTROL_MESSAGE_IMIN  uint16
    +-rw CONTROL_MESSAGE_IMAX  uint16
    +-rw CONTROL_MESSAGE_K     uint16
    +-rw CONTROL_MESSAGE_TIMER_EXPIRATIONS uint16
    +-rw MC_address*        yang:ipv6-address
+-ro mpl-seeds* [seedID, domainID]
  +-ro seedID             uint64
  +-ro domainID           uint16
  +-ro local               boolean
  +-ro life-time          uint64
  +-ro min-seqno          uint8
  +-ro data-number         uint8
  +-ro control-number      uint8
  +-ro nr-of-timers       uint8
  +-ro seed_timers* [seqno]
    +-ro seqno              uint8
    +-ro I                  uint8
    +-ro c                  uint8
    +-ro e                  uint8
    +-ro t                  uint8
+-ro mpl-statistics* [seedID, domainID]
  +-ro seedID             uint64
  +-ro domainID           uint16
  +-ro c-too-high         uint64
  +-ro nr-forwarded       uint64
  +-ro nr-not-forwarded   uint64
  +-ro nr-of-messages-received uint64
  +-ro nr-of-copies-received uint64
  +-ro nr-of-messages-forwarded uint64
  +-ro nr-of-copies-forwarded  uint64
  +-ro nr-of-refused      uint64
```

van der Stok & Thubert Expires September 8, 2016

[Page 4]

```
+--ro nr-of-notreceived      uint64
+--ro nr-of-missing          uint64
+--ro nr-of-inconsistent-data uint64
+--ro nr-of-consistent-data  uint64
+--ro nr-of-inconsistent-control uint64
+--ro nr-of-consistent-control uint64
```

### [3. ietf-yang-mpl module](#)

This section contains the ietf-yang-mpl module. The model is based on the MPL specification published in [[RFC7731](#)] and the specification of [[RFC6206](#)]. The identification of the interfaces follows the specification of ietf-interfaces of [[RFC7223](#)].

The data model allows to set values of parameters of the MPL algorithm. This approach requires an active manager process to set the values without use of DHCP as described in:  
[\[I-D.ietf-roll-mpl-parameter-configuration\]](#).

```
<CODE BEGINS>
module ietf-yang-mpl {

yang-version 1;

namespace
    "urn:ietf:params:xml:ns:yang:ietf-yang-mpl";

prefix mpl;

import ietf-inet-types{
    prefix inet;
}

organization
    "IETF ROLL (Routing over Low power and lossy networks) Working Group";

contact
    "WG Web: http://tools.ietf.org/wg/roll/
WG List: mailto:roll@ietf.org

WG Chair: Michael Richardson
mailto:mcr@ietf.org

WG Chair: Ines Robles
mailto:maria.ines.robles@ericsson.com

Editor: Peter van der Stok
```

van der Stok & Thubert Expires September 8, 2016

[Page 5]

mailto:consultancy@vanderstok.org

Editor: Pascal Thubert  
mailto:pthubert@cisco.com";

description

"This module contains information about the operation of the MPL protocol.

Copyright (c) 2016 IETF Trust and the persons identified as authors of the code. All rights reserved.

Redistribution and use in source and binary forms, with or

without modification, is permitted pursuant to, and subject to the license terms contained in, the Simplified BSD License set forth in [Section 4.c](#) of the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>).

This version of this YANG module is part of RFC XXXX; see the RFC itself for full legal notices.";

```
revision "2016-01-20" {
    description "Initial revision.";
    reference
        "I-D:draft-vanderstok-roll-mpl-yang: A YANG model for Multicast Protocol for Low power and lossy Networks (MPL)";
}
```

```
container yangmpl {
    description
        "This container describes the data model for MPL servers. The model consists of the following parts: (1) a mpl-domain part that describes the MPL-domains and associated Multicast addresses and the interfaces on which the Multicast addresses are enabled, (2) a mpl-op part that describes the parameters settings per seed, (3) a mpl-seeds part that describes the MPL buffer contents and the Trickle timer values, and (4) a mpl-statistics part that describes the number of lost and correctly forwarded messages.";
```

```
container mpl-domain {
    config true;
    description
        "The entries describe the MPL domains, the associated Multicast addresses and interfaces.";
```

```
list domains {
    key "domainID";
    description
        "The entries describe a given domain identified with domainID and the
```

```
associated
    Multicast addresses.";

leaf domainID {
    type uint16;
    description
        "Entry uniquely identifies the domain in the
```

```
        forwarder.";  
    }  
  
    leaf-list Mclist{  
        type inet:ipv6-address;  
        description  
            "List of associated IPv6 Addresses.";  
    }  
} // domains list  
  
list addresses {  
    key "MCaddress";  
    description  
        "The entries describe the interfaces enabled with a given  
        MC address.";  
  
    leaf MCaddress {  
        type inet:ipv6-address;  
        description  
            "MC address belonging to a MPL domain.";  
    }  
  
    leaf-list interfaces {  
        type string;  
        description  
            "List of names of interfaces enabled for this Multicast address.  
Interface name is defined in [RFC6206].";  
    }  
} // addresses list  
} // container mpl-domain  
  
  
container mpl-op {  
    config true;  
    description  
        "Parameter settings for each MPL server and for each individual domain  
of the server.";  
  
    leaf SE_LIFETIME {  
        type uint16;  
        description  
            "lifetime in milliseconds/(mpl timer units),  
            equivalent to SEED_SET_ENTRY_LIFETIME/TUNIT as  
            specified in ietf-roll-mpl-parameter-  
            configuration.";  
    }  
  
    leaf PROACTIVE_FORWARDING {
```

```
type boolean;
```

```
description
  "The boolean value indicates whether the MPL forwarder
  schedules MPL data message transmission after
  receiving them for the first time.";
}

leaf SEED_SET_ENTRY_LIFETIME {
  type uint64;
  description
    "The value indicates the minimum lifetime for an entry
     in the Seed set expressed in seconds. Default value
     is 30 minutes.";
}

list mpl-parameter{
  key "domainID";
  description
    "Each domain has a set of MPL forwarding parameters
     which regulate the forwarding operation.";

  leaf domainID{
    type uint16;
    description
      "Each domainID must be present in  mpl-parameter list.";
  }

  leaf DATA_MESSAGE_IMIN{
    type uint16;
    description
      "The minimum Trickle timer interval, as defined in
       [RFC6206], for MPL Data Message transmissions.";
  }

  leaf DATA_MESSAGE_IMAX{
    type uint16;
    default DATA_MESSAGE_IMIN;
    description
      "The maximum Trickle timer interval, as defined in
       [RFC6206], for MPL Data Message transmissions.";
  }

  leaf DATA_MESSAGE_K{
    type uint16;
    default 1;
    description
      "The redundancy constant, as defined in [RFC6206], for
       MPL Data Message transmissions.";
  }
}
```

van der Stok & Thubert Expires September 8, 2016

[Page 8]

```
leaf DATA_MESSAGE_TIMER_EXPIRATIONS{
  type uint16;
  default 3;
  description
    "The number of Trickle timer expirations that occur
     before terminating the Trickle algorithm's
     retransmission of a given MPL Data Message.";
}

leaf CONTROL_MESSAGE_IMIN{
  type uint16;
  description
    "The minimum Trickle timer interval, as defined
     in [RFC6206], for MPL Control Message
     transmissions.";
}

leaf CONTROL_MESSAGE_IMAX{
  type uint16;
  // default SE_LIFETIME * 300000;
  description
    "The maximum Trickle timer interval, as defined
     in [RFC6206], for MPL Control Message
     transmissions.";
}

leaf CONTROL_MESSAGE_K{
  type uint16;
  default 1;
  description
    "The redundancy constant, as defined in [RFC6206],
     for MPL Control Message transmissions.";
}

leaf CONTROL_MESSAGE_TIMER_EXPIRATIONS{
  type uint16;
  default 10;
  description
    "The number of Trickle time expirations that occur
     before terminating the Trickle algorithm
     for MPL Control Message transmissions.";
}

leaf-list MC_addresses{
  type inet:ipv6-address;
  description
    "All the MPL multicast addresses which belong to this domain.";
}
```

van der Stok & Thubert Expires September 8, 2016

[Page 9]

```
    } // MPL parameter list
} // MPL ops

list mpl-seeds{
key "seedID domainID";
description
  "List describes all seeds that are active in the server. Seed
information contains the message buffer contents and the operational values of
I, c, sequence number and the life-times per message.";

leaf seedID{
type uint64;
description
  "value uniquely identifies the MPL Seed within a MPL
domain.";
}

leaf domainID{
type uint16;
description
  "together with seedID uniquely identifies buffer set.";
}

leaf local {
type boolean;
description
  "When local == TRUE, seed is located in this forwarder.
WHEN local == false, seed is located in different
forwarder.";
}

leaf life-time {
type uint64;
description
  " Minimum remaining lifetime of the seed entry in
SE_LIFETIME units.";
}

leaf min-seqno{
type uint8;
description
  "Lower bound sequence number for this seed.";
}

leaf data-number{
type uint8;
description
  "Number of currently buffered data messages.";
```

}

van der Stok & Thubert Expires September 8, 2016

[Page 10]

```
leaf control-number{
  type uint8;
  description
    "Number of currently buffered control messages.";
}

leaf nr-of-timers{
  type uint8;
  description
    "number of active trickle timers.";
}

list seed-timers{
  key "seqno";
  description
    " status of timers of the active message identified by seqno./";

leaf seqno{
  type uint8;
  description
    "Sequence number of message of this seed.";
}

leaf I{
  type uint8;
  description
    "Current Trickle timer interval in SE-LIFETIME units.";
}

leaf c{
  type uint8;
  description
    "number of times that identical message has been
     received in this interval.";
}

leaf e{
  type uint8;
  description
    "number of Trickle time expirations since last
     Trickle timer reset.";
}

leaf t{
  type uint8;
  description
    " number of time units expressed in SE-LIFETIME units
     since last Trickle time activation.;"
```

van der Stok & Thubert Expires September 8, 2016

[Page 11]

```
        }
    } // seed-timers
} // MPL-seeds list

list mpl-statistics{
    key "seedID domainID";
    description
        "List describes performance statistics integrated over the messages of
a seed. A message identified with a seqno can receive and forward multiple
copies";

    leaf seedID{
        type uint64;
        description
            "value uniquely identifies the MPL Seed within a MPL
domain.";
    }

    leaf domainID{
        type uint16;
        description
            "together with seed-ID uniquely identifies buffer set.";
    }

    leaf c-too-high {
        type uint64;
        description
            "Number of times that a message copy was not forwarded
because c > k.";
    }

    leaf nr-forwarded {
        type uint64;
        description
            "number of times message copies are forwarded.";
    }

    leaf nr-not-forwarded {
        type uint64;
        description
            "number of times no copies of a message are forwarded at all.";
    }

    leaf nr-of-messages-received{
        type uint64;
        description
            "number of messages received, must be smaller than or equal to
seqno.";
```

}

leaf nr-of-copies-received{

```
type uint64;
description
    "number of message copies received.";
}

leaf nr-of-messages-forwarded{
type uint64;
description
    "number of forwarded messages, must be smaller than or equal to nr-
of-messages-received.";
}

leaf nr-of-copies-forwarded{
type uint64;
description
    "number of forwarded copies.";
}

leaf nr-of-refused{
type uint64;
description
    "number of refused messages because seqno too small.";
}

leaf nr-of-notreceived{
type uint64;
description
    "number of messages that are were not received
     according to control message.";
}

leaf nr-of-missing{
type uint64;
description
    "number of messages that were not received by a
     neighbour according to control message.";
}

leaf nr-of-inconsistent-data{
type uint64;
description
    "number of inconsistent data messages.";
}

leaf nr-of-consistent-data{
type uint64;
description
    "number of consistent data messages.",
```

}

van der Stok & Thubert Expires September 8, 2016

[Page 13]

```
leaf nr-of-consistent-control{  
    type uint64;  
    description  
        "number of consistent control messages.";  
}  
  
leaf nr-of-inconsistent-control{  
    type uint64;  
    description  
        "number of inconsistent control messages.";  
}  
} // mpl statistics  
} // yang-mpl  
} // module ietf-yang-mpl
```

<CODE ENDS>

#### [\*\*4. IANA Considerations\*\*](#)

#### [\*\*5. Acknowledgements\*\*](#)

Andy Bierman has commented on the use of YANG for mpl.

#### [\*\*6. Changelog\*\*](#)

Changes from version 00 to version 01

- o first change

#### [\*\*7. References\*\*](#)

##### [\*\*7.1. Normative References\*\*](#)

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), DOI 10.17487/RFC2119, March 1997, <<http://www.rfc-editor.org/info/rfc2119>>.

[RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", [RFC 6020](#), DOI 10.17487/RFC6020, October 2010, <<http://www.rfc-editor.org/info/rfc6020>>.



- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", [RFC 6241](#), DOI 10.17487/RFC6241, June 2011, <<http://www.rfc-editor.org/info/rfc6241>>.
- [RFC7223] Bjorklund, M., "A YANG Data Model for Interface Management", [RFC 7223](#), DOI 10.17487/RFC7223, May 2014, <<http://www.rfc-editor.org/info/rfc7223>>.
- [RFC7731] Hui, J. and R. Kelsey, "Multicast Protocol for Low-Power and Lossy Networks (MPL)", [RFC 7731](#), DOI 10.17487/RFC7731, February 2016, <<http://www.rfc-editor.org/info/rfc7731>>.

## **7.2. Informative References**

- [RFC6206] Levis, P., Clausen, T., Hui, J., Gnawali, O., and J. Ko, "The Trickle Algorithm", [RFC 6206](#), DOI 10.17487/RFC6206, March 2011, <<http://www.rfc-editor.org/info/rfc6206>>.
- [I-D.ietf-roll-mpl-parameter-configuration]  
Doi, Y. and M. Gillmore, "MPL Parameter Configuration Option for DHCPv6", [draft-ietf-roll-mpl-parameter-configuration-08](#) (work in progress), November 2015.

## Authors' Addresses

Peter van der Stok (editor)  
consultant

Phone: +31-492474673 (Netherlands), +33-966015248 (France)  
Email: consultancy@vanderstok.org  
URI: [www.vanderstok.org](http://www.vanderstok.org)

Pascal Thubert  
Cisco Systems, Inc  
Building D  
45 Allee des Ormes - BP1200  
MOUGINS - Sophia Antipolis 06254  
FRANCE

Phone: +33 497 23 26 34  
Email: [pthubert@cisco.com](mailto:pthubert@cisco.com)

