

Internet Engineering Task Force
Internet-Draft
Intended status: Standards Track
Expires: May 3, 2012

K. Korte
J. Schoenwaelder
A. Sehgal
Jacobs University
T. Tsou
C. Zhou
Huawei Technologies
October 31, 2011

Definition of Managed Objects for the IPv6 Routing Protocol for Low
Power and Lossy Networks (RPL)
draft-sehgal-roll-rpl-mib-02

Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it defines objects for managing the IPv6 Routing Protocol for Low Power and Lossy Networks (RPL).

Status of This Memo

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

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

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."

The list of current Internet-Drafts can be accessed at <http://www.ietf.org/ietf/lid-abstracts.txt>.

The list of Internet-Draft Shadow Directories can be accessed at <http://www.ietf.org/shadow.html>.

This Internet-Draft will expire on May 3, 2012.

Copyright Notice

Copyright (c) 2011 IETF Trust and the persons identified as the document authors. All rights reserved.

Internet-Draft

RPL MIB

October 2011

This document is subject to [BCP 78](http://trustee.ietf.org/license-info) 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 BSD License.

Table of Contents

1.	Introduction	3
2.	The Internet-Standard Management Framework	3
3.	Conventions	3
4.	Overview	3
5.	Relationship to Other MIB Modules	5
6.	Definitions	5
7.	Security Considerations	23
8.	IANA Considerations	23
9.	References	24
9.1.	Normative References	24
9.2.	Informative References	24
Appendix A.	Open Issues	25

Internet-Draft

RPL MIB

October 2011

[1.](#) Introduction

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols. In particular it defines objects for managing the IPv6 Routing Protocol for Low Power and Lossy Networks (RPL) [[I-D.ietf-roll-rpl](#)].

[2.](#) The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to [section 7 of RFC 3410](#) [[RFC3410](#)].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIV2, which is described in STD 58, [RFC 2578](#) [[RFC2578](#)], STD 58, [RFC 2579](#) [[RFC2579](#)] and STD 58, [RFC 2580](#) [[RFC2580](#)].

[3.](#) Conventions

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 [RFC 2119](#) [[RFC2119](#)].

[4.](#) Overview

The MIB module is organized into a group of scalars and tables.

```
rplMib(1.3.6.1.2.1.8888)
|
+-rplNotifications(0)
|
```

```

+-rplObjects(1)
|
|+-rplGeneral(1)
| |
| |+- rwn RplDISMode rplDefaultDISMode(1)
| |
|+-rplActive(2)
| |
| |+- rwn RplInstanceID rplActiveInstance(1)
| |+- rwn InetAddressIPv6 rplActiveDodag(2)
| |+- r-n Unsigned32 rplActiveDodagDAOSequence(3)
| |+- rwn Unsigned32 rplActiveDodagTriggerSequence(4)

```

```

|
|+-rplOCPTable(3)
| |
| |+-rplOCPEntry(1) [rplOCPCodepoint]
| | |
| | |+- --- RplObjectiveCodePoint rplOCPCodepoint(1)
| | |+- rwn TruthValue rplOCPEnabled(2)
| |
|+-rplRPLInstanceTable(4)
| |
| |+-rplRPLInstanceEntry(1) [rplRPLInstanceID]
| | |
| | |+- --- RplInstanceID rplRPLInstanceID(1)
| | |+- rwn RplObjectiveCodePoint rplRPLInstanceOCP(2)
| | |+- rwn RplDISMode rplRPLInstanceDisMode(3)
| | |+- rwn Enumeration rplRPLInstanceDAOAcknowledgement(4)
| | |+- rwn RplModeOfOperation rplRPLInstanceModeOfOperation(5)
| |
|+-rplDodagTable(5)
| |
| |+-rplDodagEntry(1) [rplRPLInstanceID,rplDodagRoot]
| | |
| | |+- --- InetAddressIPv6 rplDodagRoot(1)
| | |+- r-n RplDodagVersionNumber rplDodagVersion(2)
| | |+- r-n RplRank rplDodagRank(3)
| | |+- r-n Enumeration rplDodagState(4)
| | |+- r-n RplDAODelay rplDodagDAODelay(5)
| | |+- r-n RplDodagPreference rplDodagPreference(6)
| | |+- r-n RplMinHopRankIncrease rplDodagMinHopRankIncrease(7)

```

```

|      +- r-n Unsigned32          rplDodagMaxRankIncrease(8)
|      +- r-n Unsigned32          rplDodagIntervalDoublings(9)
|      +- r-n Unsigned32          rplDodagIntervalMin(10)
|      +- r-n Unsigned32          rplDodagRedundancyConstant(11)
|      +- r-n RplPathControlSize  rplDodagPathControlSize(12)
|
+-rplDodagParentTable(6)
|
|      +-rplDodagParentEntry(1) [rplRPLInstanceID,rplDodagRoot,
|                                rplDodagParentID]
|
|      +- --- InetAddressIPv6 rplDodagParentID(1)
|      +- r-n InterfaceIndex  rplDodagParentIf(2)
|
+-rplDodagChildTable(7)
|
|      +-rplDodagChildEntry(1) [rplRPLInstanceID,rplDodagRoot,
|                                rplDodagChildID]
|
|

```

```

|      +- r-n InetAddressIPv6 rplDodagChildID(1)
|
+-rplDodagPrefixTable(8)
|
|      +-rplDodagPrefixEntry(1) [rplRPLInstanceID,rplDodagRoot,
|                                rplDodagPrefixIpv6Prefix,
|                                rplDodagPrefixIpv6PrefixLength]
|
|      +- r-n InetAddressIPv6          rplDodagPrefixIpv6Prefix(1)
|      +- r-n InetAddressPrefixLength  rplDodagPrefixIpv6PrefixLength(2)
|
+-rplStats(9)
|
|      +- r-n Counter32 rplStatsMemOverflows(1)
|      +- r-n Counter32 rplStatsValidParentFailures(2)
|      +- r-n Counter32 rplStatsNoInstanceIDs(3)
|      +- r-n Counter32 rplStatsTriggeredLocalRepairs(4)
|      +- r-n Counter32 rplStatsTriggeredGlobalRepairs(5)
|      +- r-n Counter32 rplStatsParseErrors(6)
|      +- r-n Counter32 rplStatsNoParentSecs(7)
|      +- r-n Counter32 rplStatsActiveNoParentSecs(8)
|      +- r-n Counter32 rplStatsOBitSetDownwards(9)

```

```
-- r-n Counter32 rplStatsOBitClearedUpwards(10)
-- r-n Counter32 rplStatsFBitSet(11)
-- r-n Counter32 rplStatsRBitSet(12)
```

5. Relationship to Other MIB Modules

The MIB module IMPORTS definitions from SNMPv2-SMI [[RFC2578](#)], SNMPv2-TC [[RFC2579](#)], SNMPv2-CONF [[RFC2580](#)], IF-MIB [[RFC2863](#)] and the INET-ADDRESS-MIB [[RFC4001](#)].

6. Definitions

```
RPL-MIB DEFINITIONS ::= BEGIN
```

```
IMPORTS
```

```
    MODULE-IDENTITY, OBJECT-TYPE, Unsigned32, Counter32, mib-2
        FROM SNMPv2-SMI                                -- RFC 2578
    TEXTUAL-CONVENTION, TruthValue
        FROM SNMPv2-TC                                  -- RFC 2579
    OBJECT-GROUP, MODULE-COMPLIANCE
        FROM SNMPv2-CONF                                -- RFC 2580
    InterfaceIndex
        FROM IF-MIB                                     -- RFC 2863
    InetAddressIPv6, InetAddressPrefixLength
        FROM INET-ADDRESS-MIB;                          -- RFC 4001
    -- XXX Are we sure RPL will never ever support a different
```

```
-- XXX version of IP?
```

```
rplMib MODULE-IDENTITY
```

```
    LAST-UPDATED "201110310000Z"
```

```
    ORGANIZATION
```

```
        "Jacobs University Bremen"
```

```
    CONTACT-INFO
```

```
        "Kevin Dominik Korte
```

```
        Jacobs University Bremen
```

```
        Email: k.korte@jacobs-university.de
```

```
        Anuj Sehgal
```

```
        Jacobs University Bremen
```

```
        Email: s.anuj@jacobs-university.de
```

Juergen Schoenwaelder
Jacobs University Bremen
Email: j.schoenwaelder@jacobs-university.de

Tina Tsou
Huawei Technologies
Email: tena@huawei.com

Cathy Zhou
Huawei Technologies
Email: cathyzhou@huawei.com"

DESCRIPTION

"The MIB module for monitoring nodes implementing the IPv6 routing protocol for low power and lossy networks (RPL).

Copyright (c) 2011 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>)."

REVISION "201110310000Z"

DESCRIPTION

"Initial version, published as RFC XXXX."

-- RFC Ed.: replace XXXX with actual RFC number & remove this note

::= { mib-2 XXXX }

RplInstanceID ::= TEXTUAL-CONVENTION

DISPLAY-HINT "d"

STATUS current

DESCRIPTION

"A global or local RplInstanceID as defined in [Section 5.1](#). of RFC YYYY."

REFERENCE

"RFC YYYY: RPL: IPv6 Routing Protocol for LLNs"

SYNTAX Unsigned32 (0..255)

RplDodagVersionNumber ::= TEXTUAL-CONVENTION
 DISPLAY-HINT "d"
 STATUS current
 DESCRIPTION
 "The version number of a DODAG as defined in [Section 6.3](#) of
 RFC YYYY."
 REFERENCE
 "RFC YYYY: RPL: IPv6 Routing Protocol for LLNs"
 SYNTAX Unsigned32 (0..255)

RplRank ::= TEXTUAL-CONVENTION
 DISPLAY-HINT "d"
 STATUS current
 DESCRIPTION
 "The rank of a node within a DODAG as defined in [Section 6.3](#)
 of RFC YYYY."
 REFERENCE
 "RFC YYYY: RPL: IPv6 Routing Protocol for LLNs"
 SYNTAX Unsigned32 (0..65535)

RplObjectiveCodePoint ::= TEXTUAL-CONVENTION
 DISPLAY-HINT "d"
 STATUS current
 DESCRIPTION
 "The Objective Code Point of a DODAG as defined in
 [Section 6.7.6](#) of RFC YYYY."
 REFERENCE
 "RFC YYYY: RPL: IPv6 Routing Protocol for LLNs"
 SYNTAX Unsigned32 (0..65535)

RplDISMode ::= TEXTUAL-CONVENTION
 STATUS current
 DESCRIPTION
 "Determines whether a DIS message is send upon boot-up
 or not as defined in [Section 17.2.1.1](#) of RFC YYYY:
 silent(1) do not send DIS messages
 send(2) send DIS messages"
 REFERENCE


```

SYNTAX      INTEGER {
                silent(1),
                send(2)
            }

```

```

RplModeOfOperation ::= TEXTUAL-CONVENTION
    STATUS          current
    DESCRIPTION
        "Determines the mode of operation."
    REFERENCE
        "RFC YYYY: RPL: IPv6 Routing Protocol for LLNs"
    SYNTAX          INTEGER {
                noDownwardRoutes(0),
                nonStoringMode(1),
                storingWithoutMulticastSupport(2),
                storingWithMulticastSupport(3)
            }

```

```

RplDAODelay ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS          current
    DESCRIPTION
        "The delay time used for aggregation before a DAO message
         is send."
    REFERENCE
        "RFC YYYY: RPL: IPv6 Routing Protocol for LLNs"
    SYNTAX          Unsigned32

```

```

RplDodagPreference ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS          current
    DESCRIPTION
        "The preference of a DODAG compared to another DODAG of the
         same instance as defined in Section 6.3 of RFC YYYY."
    REFERENCE
        "RFC YYYY: RPL: IPv6 Routing Protocol for LLNs"
    SYNTAX          Unsigned32 (0..7)

```

```

RplMinHopRankIncrease ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS          current
    DESCRIPTION
        "The minimal incerease of a rank within a single hop as
         defined in Section 6.7.6 of RFC YYYY."
    REFERENCE
        "RFC YYYY: RPL: IPv6 Routing Protocol for LLNs"
    SYNTAX          Unsigned32 (0..131071)

```

```
RplPathControlSize ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS      current
    DESCRIPTION
        "The Path Control Size within a DODAG as defined in
        Section 6.7.6 of RFC YYYY."
    REFERENCE
        "RFC YYYY: RPL: IPv6 Routing Protocol for LLNs"
    SYNTAX      Unsigned32 (0..7)

-- object definitions

rplNotifications OBJECT IDENTIFIER ::= { rplMib 0 }
rplObjects       OBJECT IDENTIFIER ::= { rplMib 1 }
rplConformance  OBJECT IDENTIFIER ::= { rplMib 2 }

rplGeneral OBJECT IDENTIFIER ::= { rplObjects 1 }

rplDefaultDISMode OBJECT-TYPE
    SYNTAX      RplDISMode
    MAX-ACCESS   read-write
    STATUS      current
    DESCRIPTION
        "Determines whether a DIS message is send upon boot-up."
    ::= { rplGeneral 1 }
    -- XXX should be able to configure the number of DIS messages
    -- XXX and related timer, see 17.2.1.1.
    -- XXX need to say something about persistence across reboots

    -- XXX Should there be more objects to configure default timers
    -- XXX etc that are applied to all DODAGs etc?

rplActive OBJECT IDENTIFIER ::= { rplObjects 2 }

rplActiveInstance OBJECT-TYPE
    SYNTAX      RplInstanceID
    MAX-ACCESS   read-write
    STATUS      current
    DESCRIPTION
        "The currently active RPL Instance."
    ::= { rplActive 1 }
    -- XXX need to say something about persistence across reboots

rplActiveDodag OBJECT-TYPE
    SYNTAX      InetAddressIPv6
    MAX-ACCESS   read-write
```

STATUS current
DESCRIPTION

Korte, et al.

Expires May 3, 2012

[Page 9]

Internet-Draft

RPL MIB

October 2011

 "The currently active RPL DODAG in the active RPL Instance."
 ::= { rplActive 2 }

rplActiveDodagDAOSequence OBJECT-TYPE

SYNTAX Unsigned32 (0..255)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

 "The DAO message sequence number (DAOSequence) of the active
 DODAG as defined in [Section 6.5.1](#) of RFC YYYY."

REFERENCE

 "RFC YYYY: RPL: IPv6 Routing Protocol for LLNs"

::= { rplActive 3 }

rplActiveDodagTriggerSequence OBJECT-TYPE

SYNTAX Unsigned32 (0..255)

MAX-ACCESS read-write

STATUS current

DESCRIPTION

 "The DAO Trigger Sequence Number (DTSN) of the active
 DODAG as defined in [Section 6.3.1](#) of RFC YYYY."

REFERENCE

 "RFC YYYY: RPL: IPv6 Routing Protocol for LLNs"

::= { rplActive 4 }

rpLOCPTable OBJECT-TYPE

SYNTAX SEQUENCE OF RplOCPEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

 "The table of all supported Objective Code Points (OCPs)."

::= { rplObjects 3 }

rplOCPEntry OBJECT-TYPE

SYNTAX RplOCPEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

 "An entry representing a supported Objective Code Point."

```
INDEX { rplOCPCodepoint }  
 ::= { rplOCPTable 1 }
```

```
RplOCPEntry ::= SEQUENCE {  
    rplOCPCodepoint  RplObjectiveCodePoint,  
    rplOCPEnabled    TruthValue  
}
```

rplOCPCodepoint OBJECT-TYPE

Korte, et al.

Expires May 3, 2012

[Page 10]

Internet-Draft

RPL MIB

October 2011

```
SYNTAX      RplObjectiveCodePoint  
MAX-ACCESS  not-accessible  
STATUS      current  
DESCRIPTION  
    "A supported Objective Code Point."  
 ::= { rplOCPEntry 1 }
```

```
rplOCPEnabled OBJECT-TYPE  
SYNTAX      TruthValue  
MAX-ACCESS  read-write  
STATUS      current  
DESCRIPTION  
    "Enables the usage of this Objective Code Point."  
 ::= { rplOCPEntry 2 }  
-- XXX need to say something about persistence across reboots
```

```
rplRPLInstanceTable OBJECT-TYPE  
SYNTAX      SEQUENCE OF RplRPLInstanceEntry  
MAX-ACCESS  not-accessible  
STATUS      current  
DESCRIPTION  
    "The table represents information about all known  
    RPL Instances."  
 ::= { rplObjects 4 }
```

```
rplRPLInstanceEntry OBJECT-TYPE  
SYNTAX      RplRPLInstanceEntry  
MAX-ACCESS  not-accessible  
STATUS      current  
DESCRIPTION  
    "An entry representing information about a RPL Instance."  
INDEX { rplRPLInstanceID }
```

```

::= { rplRPLInstanceTable 1 }
-- XXX This should likely be a read-create table.

RplRPLInstanceEntry ::= SEQUENCE {
    rplRPLInstanceID          RplInstanceID,
    rplRPLInstanceOCP         RplObjectiveCodePoint,
    rplRPLInstanceDisMode     RplDISMode,
    rplRPLInstanceDAOAcknowledgement INTEGER,
    rplRPLInstanceModeOfOperation RplModeOfOperation
}

```

```

rplRPLInstanceID OBJECT-TYPE
    SYNTAX          RplInstanceID
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION

```

Korte, et al.

Expires May 3, 2012

[Page 11]

Internet-Draft

RPL MIB

October 2011

```

    "The InstanceID of this RPL Instance."
    ::= { rplRPLInstanceEntry 1 }

rplRPLInstanceOCP OBJECT-TYPE
    SYNTAX          RplObjectiveCodePoint
    MAX-ACCESS      read-write
    STATUS          current
    DESCRIPTION
        "The Objective Code Point of this RPL Instance."
    ::= { rplRPLInstanceEntry 2 }
    -- XXX If this is read-write, what is the persistence?
    -- XXX Support provisioning of table entries on border routers?
    -- XXX If so, use StorageType and RowStatus?

rplRPLInstanceDisMode OBJECT-TYPE
    SYNTAX          RplDISMode
    MAX-ACCESS      read-write
    STATUS          current
    DESCRIPTION
        "Determines whether a DIS message is send for this instance
        upon boot-up."
    ::= { rplRPLInstanceEntry 3 }
    -- XXX Check how this works together with the global toggle.
    -- XXX should we allow per instance parameters such as the number
    -- XXX of DIS messages and related timer, see 17.2.1.1?

```

rplRPLInstanceDAOAcknowledgement OBJECT-TYPE

SYNTAX INTEGER {
nope(1)
}

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"The mode of Operation of the RPL instance."

::= { rplRPLInstanceEntry 4 }

-- XXX What is this? Kevin?

-- XXX persistence?

rplRPLInstanceModeOfOperation OBJECT-TYPE

SYNTAX RplModeOfOperation

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"The mode of Operation of the RPL instance."

::= { rplRPLInstanceEntry 5 }

-- XXX persistence?

rplDodagTable OBJECT-TYPE

SYNTAX SEQUENCE OF RplDodagEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The table represents information about all locally known
DODAGs."

::= { rplObjects 5 }

-- XXX The root needs a bit(?) config, where does that go?

rplDodagEntry OBJECT-TYPE

SYNTAX RplDodagEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry representing information about a DODAG."

INDEX { rplRPLInstanceID, rplDodagRoot }

::= { rplDodagTable 1 }

```

RplDodagEntry ::= SEQUENCE {
    rplDodagRoot          InetAddressIPv6,
    rplDodagVersion       RplDodagVersionNumber,
    rplDodagRank          RplRank,
    rplDodagState         INTEGER,
    rplDodagDAODelay      RplDAODelay,
    rplDodagPreference    RplDodagPreference,
    rplDodagMinHopRankIncrease RplMinHopRankIncrease,
    rplDodagMaxRankIncrease Unsigned32,
    rplDodagIntervalDoublings Unsigned32,
    rplDodagIntervalMin   Unsigned32,
    rplDodagRedundancyConstant Unsigned32,
    rplDodagPathControlSize RplPathControlSize
}

```

```

rplDodagRoot OBJECT-TYPE
    SYNTAX      InetAddressIPv6
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The identifier of a DODAG root (DODAGID) of this RPL
        instance. The root of the DODAG reports its own IPv6
        address as the DODAG root."
    ::= { rplDodagEntry 1 }

```

```

rplDodagVersion OBJECT-TYPE
    SYNTAX      RplDodagVersionNumber
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION

```

```

        "The version of the DODAG in this RPL instance."
    ::= { rplDodagEntry 2 }

```

```

rplDodagRank OBJECT-TYPE
    SYNTAX      RplRank
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The rank of the node within the DODAG."
    ::= { rplDodagEntry 3 }

```

rplDodagState OBJECT-TYPE

SYNTAX INTEGER {
other(0),
associated(1),
grounded(2),
floating(3)
}

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The status of the DODAG:

other(0) An unknown state.

associated(1) A node is associated with the RPL instance.

grounded(2) The DODAG is grounded.

floating(3) The DODAG is floating (not grounded).

"

::= { rplDodagEntry 4 }

rplDodagDAODelay OBJECT-TYPE

SYNTAX RplDAODelay

UNITS "milliseconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The delay for aggregations before a DAO is send."

::= { rplDodagEntry 5 }

-- XXX should this be configuration? If so we should add a default

-- clause to define the default value to be 1 second.

rplDodagPreference OBJECT-TYPE

SYNTAX RplDodagPreference

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"How preferred this DODAG is compared to other DODAGs
within the same instance."

::= { rplDodagEntry 6 }


```

rplDodagMinHopRankIncrease OBJECT-TYPE
    SYNTAX      RplMinHopRankIncrease
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The minimum increase of the rank in a single hop."
    ::= { rplDodagEntry 7 }
    -- XXX should this be writable at the root? If so we should add a
    -- defval clause to define the default value to be 256.

rplDodagMaxRankIncrease OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The maximum allowable increase in rank in support of local
        repair. If DAGMaxRankIncrease is 0 then this mechanism is
        disabled."
    ::= { rplDodagEntry 8 }

rplDodagIntervalDoublings OBJECT-TYPE
    SYNTAX      Unsigned32 (0..255)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The configured Imax of the DIO trickle timer."
    ::= { rplDodagEntry 9 }
    -- XXX should this be writable at the root? If so we should add a
    -- defval clause to define the default value of 20.

rplDodagIntervalMin OBJECT-TYPE
    SYNTAX      Unsigned32 (0..255)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The configured Imin of the DIO trickle timer."
    ::= { rplDodagEntry 10 }
    -- XXX should this be writable at the root? If so we should add a
    -- defval clause to define the default value of 3.

rplDodagRedundancyConstant OBJECT-TYPE
    SYNTAX      Unsigned32 (0..255)
    MAX-ACCESS  read-only

```

STATUS current

DESCRIPTION

"The configured k of the DIO trickle timer."

::= { rplDodagEntry 11 }

-- XXX should this be writable at the root? If so we should add a

-- defval clause to define the default value of 10.

rplDodagPathControlSize OBJECT-TYPE

SYNTAX RplPathControlSize

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The Path Control Size of this DODAG."

::= { rplDodagEntry 12 }

rplDodagParentTable OBJECT-TYPE

SYNTAX SEQUENCE OF RplDodagParentEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The list of parents for a DODAG."

::= { rplObjects 6 }

rplDodagParentEntry OBJECT-TYPE

SYNTAX RplDodagParentEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Information about a known DODAG parent."

INDEX { rplRPLInstanceID, rplDodagRoot, rplDodagParentID }

::= { rplDodagParentTable 1 }

RplDodagParentEntry ::= SEQUENCE {

rplDodagParentID InetAddressIPv6,

rplDodagParentIf InterfaceIndex

}

rplDodagParentID OBJECT-TYPE

SYNTAX InetAddressIPv6

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An RPL parent associated with this DODAG."

::= { rplDodagParentEntry 1 }

rplDodagParentIf OBJECT-TYPE

SYNTAX InterfaceIndex

Internet-Draft

RPL MIB

October 2011

```
STATUS      current
DESCRIPTION
    "The interface over which the parent can be reached."
 ::= { rplDodagParentEntry 2 }
```

```
rplDodagChildTable OBJECT-TYPE
SYNTAX      SEQUENCE OF RplDodagChildEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The list of children for a DODAG."
 ::= { rplObjects 7 }
```

```
rplDodagChildEntry OBJECT-TYPE
SYNTAX      RplDodagChildEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "Information about a known DODAG child."
INDEX { rplRPLInstanceID, rplDodagRoot, rplDodagChildID }
 ::= { rplDodagChildTable 1 }
```

```
RplDodagChildEntry ::= SEQUENCE {
    rplDodagChildID InetAddressIPv6
}
```

```
rplDodagChildID OBJECT-TYPE
SYNTAX      InetAddressIPv6
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "An RPL child associated with this DODAG."
 ::= { rplDodagChildEntry 1 }
```

```
rplDodagPrefixTable OBJECT-TYPE
SYNTAX      SEQUENCE OF RplDodagPrefixEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "List of prefixes associated with a DODAG."
```

```
::= { rplObjects 8 }
-- XXX Explain how this relates to the ipAddressPrefixTable in
-- XXX the IP-MIB
```

```
rplDodagPrefixEntry OBJECT-TYPE
    SYNTAX      RplDodagPrefixEntry
    MAX-ACCESS  not-accessible
    STATUS      current
```

Korte, et al.

Expires May 3, 2012

[Page 17]

Internet-Draft

RPL MIB

October 2011

DESCRIPTION

"Information about a prefix associated with a DODAG."

```
INDEX { rplRPLInstanceID, rplDodagRoot,
        rplDodagPrefixIpv6Prefix, rplDodagPrefixIpv6PrefixLength }
::= { rplDodagPrefixTable 1 }
```

```
RplDodagPrefixEntry ::= SEQUENCE {
    rplDodagPrefixIpv6Prefix      InetAddressIPv6,
    rplDodagPrefixIpv6PrefixLength InetAddressPrefixLength
}
```

```
rplDodagPrefixIpv6Prefix OBJECT-TYPE
```

```
    SYNTAX      InetAddressIPv6
```

```
    MAX-ACCESS  read-only
```

```
    STATUS      current
```

DESCRIPTION

"The IPv6 address forming the IPv6 prefix."

```
::= { rplDodagPrefixEntry 1 }
```

```
rplDodagPrefixIpv6PrefixLength OBJECT-TYPE
```

```
    SYNTAX      InetAddressPrefixLength
```

```
    MAX-ACCESS  read-only
```

```
    STATUS      current
```

DESCRIPTION

"The length of the IPv6 prefix."

```
::= { rplDodagPrefixEntry 2 }
```

```
-- XXX The routing table should be exposed via the inetCidrRouteTable
-- XXX defines in the IP-FORWARD-MIB (RFC 4292). We need to clarify
-- XXX whether the inetCidrRoutePolicy can / should point to the DODAG
-- XXX instance. Furthermore, this document should request that IANA
-- XXX allocates a number for RPL in the IANAipRouteProtocol TC.
```

rplStats OBJECT IDENTIFIER ::= { rplObjects 9 }

rplStatsMemOverflows OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of memory allocation failures (e.g., routing table overflows)."

::= { rplStats 1 }

rplStatsValidParentFailures OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times a packet could not be sent to a DODAG parent flagged as valid."

::= { rplStats 2 }

rplStatsNoInstanceIDs OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times a packet could not be sent because of a missing RPLInstanceID."

::= { rplStats 3 }

rplStatsTriggeredLocalRepairs OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times a local repair procedure was triggered."

::= { rplStats 4 }

rplStatsTriggeredGlobalRepairs OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times a global repair procedure was triggered."
 ::= { rplStats 5 }

rplStatsParseErrors OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of received malformed messages."
 ::= { rplStats 6 }

rplStatsNoParentSecs OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of seconds without a next hop (DODAG parent)."
 ::= { rplStats 7 }

rplStatsActiveNoParentSecs OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of seconds with packets to forward without a
 next hop (DODAG parent)."
 ::= { rplStats 8 }

rplStatsOBitSetDownwards OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Number of packets received with the 'O' bit set from
 a node with a higher rank."
 ::= { rplStats 9 }

rplStatsOBitClearedUpwards OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

```

STATUS      current
DESCRIPTION
    "Number of packets received with the 'O' bit cleared
    from a node with a lower rank."
 ::= { rplStats 10 }

rplStatsFBitSet OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "Number of packets received with the 'F' bit set."
 ::= { rplStats 11 }

rplStatsRBitSet OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "Number of packets received with the 'R' bit set."
 ::= { rplStats 12 }

-- XXX There seem to be additional local error events to count, see
-- XXX for example Section 11.2. (rank errors, forwarding errors, ...)

-- XXX RPL security has not been looked at.

rplGroups      OBJECT IDENTIFIER ::= { rplConformance 1 }
rplCompliances OBJECT IDENTIFIER ::= { rplConformance 2 }

```

```

rplFullCompliance MODULE-COMPLIANCE
STATUS      current
DESCRIPTION
    "Compliance statement for implementations supporting
    read/write access, according to the object definitions."
MODULE      -- this module
MANDATORY-GROUPS {
    rplGeneralGroup,
    rplInstanceGroup,
    rplStatsGroup
}
 ::= { rplCompliances 1 }

```

```

rplReadOnlyCompliance MODULE-COMPLIANCE
    STATUS      current
    DESCRIPTION
        "Compliance statement for implementations supporting
        only readonly access."
    MODULE      -- this module
    MANDATORY-GROUPS {
        rplGeneralGroup,
        rplInstanceGroup,
        rplStatsGroup
    }
    ::= { rplCompliances 2 }
    -- XXX Need to list all writable objects to declare them
    -- XXX readonly.

rplGeneralGroup OBJECT-GROUP
    OBJECTS {
        rplDefaultDISMode,
        rplActiveInstance,
        rplActiveDodag,
        rplActiveDodagDAOSequence,
        rplActiveDodagTriggerSequence,
        -- rplOCPCodepoint,
        rplOCPEnabled
    }
    STATUS      current
    DESCRIPTION
        "A collection of objects providing general information about
        the RPL implementation."
    ::= { rplGroups 1 }

rplInstanceGroup OBJECT-GROUP
    OBJECTS {
        -- rplRPLInstanceID,
        rplRPLInstanceOCP,

```

```

    rplRPLInstanceDisMode,
    rplRPLInstanceDAOAcknowledgement,
    rplRPLInstanceModeOfOperation,
    -- rplDodagRoot,
    rplDodagVersion,

```



```

    rplDodagRank,
    rplDodagState,
    rplDodagDAODelay,
    rplDodagPreference,
    rplDodagMinHopRankIncrease,
    rplDodagMaxRankIncrease,
    rplDodagIntervalDoublings,
    rplDodagIntervalMin,
    rplDodagRedundancyConstant,
    rplDodagPathControlSize,
    -- rplDodagParentID,
    rplDodagParentIf,
    rplDodagChildID,
    rplDodagPrefixIpv6Prefix,
    rplDodagPrefixIpv6PrefixLength
}
STATUS      current
DESCRIPTION
    "A collection of objects providing insight into the RPL
    Instances and the DODAGs."
::= { rplGroups 2 }

```

rplStatsGroup OBJECT-GROUP

```

OBJECTS {
    rplStatsMemOverflows,
    rplStatsValidParentFailures,
    rplStatsNoInstanceIDs,
    rplStatsTriggeredLocalRepairs,
    rplStatsTriggeredGlobalRepairs,
    rplStatsParseErrors,
    rplStatsNoParentSecs,
    rplStatsActiveNoParentSecs,
    rplStatsOBitSetDownwards,
    rplStatsOBitClearedUpwards,
    rplStatsFBitSet,
    rplStatsRBitSet
}
STATUS      current
DESCRIPTION
    "A collection of objects providing statistics about the
    RPL implementation."
::= { rplGroups 3 }

```

END

7. Security Considerations

There are a number of management objects defined in this MIB module with a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations. These are the tables and objects and their sensitivity/vulnerability:

- o rplActiveInstance: [TBD] explain sensitivity

Some of the readable objects in this MIB module (i.e., objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP. These are the tables and objects and their sensitivity/vulnerability:

[TODO: Need to describe vulnerabilities here.]

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPsec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [\[RFC3410\], section 8](#)), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

8. IANA Considerations

IANA is requested to assign a value for "XXX" under the 'mib-2' subtree and to record the assignment in the SMI Numbers registry. When the assignment has been made, the RFC Editor is asked to replace

Internet-Draft

RPL MIB

October 2011

"XXX" (here and in the MIB module) with the assigned value and to remove this note.

[9.](#) References

[9.1.](#) Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC2578] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIv2)", STD 58, [RFC 2578](#), April 1999.
- [RFC2579] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIv2", STD 58, [RFC 2579](#), April 1999.
- [RFC2580] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIv2", STD 58, [RFC 2580](#), April 1999.
- [RFC2863] McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB", [RFC 2863](#), June 2000.
- [RFC4001] Daniele, M., Haberman, B., Routhier, S., and J. Schoenwaelder, "Textual Conventions for Internet Network Addresses", [RFC 4001](#), February 2005.
- [I-D.ietf-roll-rpl] Winter, T., Thubert, P., Brandt, A., Clausen, T., Hui, J., Kelsey, R., Levis, P., Pister, K., Struik, R., and J. Vasseur, "RPL: IPv6 Routing Protocol for Low power and Lossy Networks", [draft-ietf-roll-rpl-19](#) (work in progress), March 2011.

[9.2.](#) Informative References

- [RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability

Korte, et al.

Expires May 3, 2012

[Page 24]

Internet-Draft

RPL MIB

October 2011

[Appendix A](#). Open Issues

Should there be basic DIS/DIO/DAO/DAO-ACK message counters?

Should we reveal the internal trickle variables? Right now, we only allow to read the configured trickle parameters.

Should we model objective functions, e.g. by introducing a table that includes things such as MinHopRankIncrease and MaxRankIncrease

Should we report the mode (storing mode, non-storing mode)?

Check the various issues marked with XXX in the RPL-MIB itself.

Authors' Addresses

Kevin Korte
Jacobs University
Campus Ring 1
Bremen 28759
Germany

EMail: k.korte@jacobs-university.de

Juergen Schoenwaelder
Jacobs University
Campus Ring 1
Bremen 28759
Germany

EMail: j.schoenwaelder@jacobs-university.de

Anuj Sehgal
Jacobs University
Campus Ring 1
Bremen 28759
Germany

EMail: s.anuj@jacobs-university.de

Korte, et al.

Expires May 3, 2012

[Page 25]

Internet-Draft

RPL MIB

October 2011

Tina Tsou
Huawei Technologies
Bantian, Longgang District
Shenzhen 518129
P.R. China

EMail: tena@huawei.com

Cathy Zhou
Huawei Technologies
Bantian, Longgang District
Shenzhen 518129
P.R. China

EMail: cathyzhou@huawei.com

