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Abstract

This draft defines a portion of the Management Information Base (MIB), the lowpan MIB for use with network management protocols. In particular it defines objects for managing functions related to a 6lowpan entity.

Internet-Draft	6lowpan	Management	Information	Base	
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July 2008

#### 1. Introduction

This draft defines a portion of the Management Information Base (MIB), the lowpan MIB for use with network management protocols. In particular it defines objects for managing functions related to a 6lowpan entity.

#### 2. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to <a href="mailto:section 7">section 7</a> of <a href="mailto:RFC3410">RFC 3410</a> [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

### 4.1. IPv6 over Wireless PAN (6LoWPAN)

Low-power wireless personal area networks (LoWPANs) comprise devices that conform to the IEEE 802.15.4-2003 standard by the IEEE [IEEE802.15.4]. IEEE 802.15.4 devices are characterized by short range, low bit rate, low power and low cost. Many of the devices employing IEEE 802.15.4 radios will be limited in their computational power, memory, and/or energy availability. This document defines a set of managed objects (MOs) that can be used to monitor and control 6lowpan entities.

### 5. Relationship to Other MIB Modules

## **5.1**. MIB modules required for IMPORTS

The following MIB module IMPORTS objects from SNMPv2-SMI [ $\frac{RFC2578}{RFC2579}$ ], SNMPv2-TC [ $\frac{RFC2579}{RFC2580}$ ] and SNMPv2-CONF [ $\frac{RFC2580}{RFC2580}$ ]

### 6. Definitions

LOWPAN-TC-MIB DEFINITIONS ::= BEGIN IMPORTS

TEXTUAL-CONVENTION
FROM SNMPv2-TC
MODULE-IDENTITY, mib-2
FROM SNMPv2-SMI;

-- definition of textual conventions

lowpanTCMIB MODULE-IDENTITY

LAST-UPDATED "200807101307Z"

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Support Group E-mail: 6lowpan@ietf.org"

**DESCRIPTION** 

"A MIB module containing textual conventions for 6lowpan data types. This module addresses an immediate need for data types not directly supported in the SMIv2.

Copyright (C) The IETF Trust 2008. This version of this MIB module is part of RFC XXXX; see the RFC itself for full legal notices."

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

REVISION "200807101307Z"

DESCRIPTION "Initial version, published as RFC XXXX."

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

::= { mib-2 XXX } -- will be assigned by IANA

- -- IANA Reg.: Please assign a value for "XXX" under the 'mib-2'
- -- subtree and record the assignment in the SMI Numbers registry.
- -- RFC Ed.: When the above assignment has been made, please
- -- remove the above note
- -- replace "XXX" here with the assigned value and
- -- remove this note.

LowpanieeEEUI64Address ::= TEXTUAL-CONVENTION

DISPLAY-HINT "1x:"

STATUS current

DESCRIPTION

"The IEEE defined 64-bit extended unique identifier (EUI-64) is a concatenation of the 24-bit company\_id value by the IEEE Registration Authority and a 40-bit extension identifier assigned by the organization with that company\_id assignment."

REFERENCE

"IEEE 64-BIT GLOBAL IDENTIFIER (EUI64)" SYNTAX OCTET STRING (SIZE (8))

LowpanShortAddress ::= TEXTUAL-CONVENTION

DISPLAY-HINT "1x:" STATUS current

DESCRIPTION

"The 16-bit Short Address used for 802.15.4 networks."

REFERENCE

"IEEE Std 802.15.4 specifications"

SYNTAX OCTET STRING (SIZE (2))

**END** 

IPV6LOWPAN-MIB DEFINITIONS ::= BEGIN
 IMPORTS

TruthValue

FROM SNMPv2-TC

OBJECT-GROUP, MODULE-COMPLIANCE

FROM SNMPv2-CONF

MODULE-IDENTITY, OBJECT-TYPE, Unsigned32, mib-2

FROM SNMPv2-SMI

LowpanIEEEEUI64Address, LowpanShortAddress

FROM LOWPAN-TC-MIB;

lowpanMIB MODULE-IDENTITY

LAST-UPDATED "200807101307Z"

ORGANIZATION "IETF 6lowpan Working Group"

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                    Support Group E-mail: 6lowpan@ietf.org"
                    "The MIB module for monitoring 6lowpan
   DESCRIPTION
                    entities.
                    Copyright (C) The IETF Trust 2008. This
                    version of this MIB module is part of RFC XXXX;
                    see the RFC itself for full legal notices."
  -- RFC Ed.: replace XXXX with actual RFC number & remove this note
   REVISION
                    "200807101307Z"
   DESCRIPTION
                       "Initial version, published as RFC XXXX."
-- RFC Ed.: replace XXXX with actual RFC number & remove this note
   ::= { mib-2 YYY } -- will be assigned by IANA
  -- IANA Reg.: Please assign a value for "YYY" under the 'mib-2'
  -- subtree and record the assignment in the SMI Numbers registry.
  -- RFC Ed.: When the above assignment has been made, please
         remove the above note
         replace "YYY" here with the assigned value and
         remove this note.
  -- The major groups
                             OBJECT IDENTIFIER ::= { lowpanMIB 0 }
  lowpanNotifications
```

OBJECT IDENTIFIER ::= { lowpanMIB 1 }

OBJECT IDENTIFIER ::= { lowpanMIB 2 }

lowpanObjects

lowpanConformance

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```
INTEGER { coordinator ( 0 ) , router ( 1 ) ,
   SYNTAX
                    endDevice ( 2 ) }
   MAX-ACCESS
                      read-only
   STATUS
                      current
                    "The device in 6lowpan can play three roles.
   DESCRIPTION
                    coordinator(0) indicates that the device is a
                    PAN Coordinator which is the primary controller
                    of the PAN. Its a full-function device (FFD).
                    It MAY initiate the synchronization of the
                    entire 6LoWPAN by transmitting beacons.
                    router(1) a FFD which has the capability of
                    routing packets to the next hop device in
                    6LoWPAN.
                    endDevice(2) RFD (Reduced function device) or
                    FFD in a 6LoWPAN, which is neither the
                    coordinator nor a router."
    ::= { lowpanObjects 1 }
lowpanDeviceCapabilities
                             OBJECT-TYPE
   SYNTAX
                      BITS { alternatePANcoordinator ( 0 ) ,
                    deviceType ( 1 ) , powerSource ( 2 ) ,
                    recieverOnWhenIdle ( 3 ) , securityCapability
                    (6), allocateAddress (7)}
   MAX-ACCESS
                      read-only
   STATUS
                      current
   DESCRIPTION
                    "alternatePANcoordinator(0) - The alternate PAN
                    coordinator subfield shall be set to 1 if the
                    device is capable of becoming a PAN
                    coordinator. Otherwise, the alternate PAN
                    coordinator subfield shall be set to 0.
                    deviceType(1) -The device type subfield shall
                    be set to 1 if the device is an FFD.
                    Otherwise, the device type subfield shall be
                    set to 0 to indicate an RFD.
                    powerSource(2) - The power source subfield
                    shall be set to 1 if the device is receiving
                    power from the alternating current mains.
                    Otherwise, the power source subfield shall
                    be set to 0.
                    recieverOnWhenIdle(3) - The receiver on when
                    idle shall be set to 1 if the device does not
                    disable its receiver to conserve power
                    during idle periods. Otherwise, the receiver
                    on when idle subfield shall be set to 0.
```

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securityCapability(6)- The security capability subfield shall be set to 1 if the device is capable of sending and receiving MAC frames secured using the security suite. Otherwise the security capability subfield shall be set to 0.

allocateAddress(7)- The allocate address subfield shall be set to 1 if the device wishes the coordinator to allocate a short address as a result of the association procedure. If this subfield is set to 0, the special short address of 0 x fffe shall be allocated to the device and returned through the association response command. In this case, the device shall communicate on the PAN using only its 64 bit extended address.

```
BITS 4-5 are reserved."
                   "IEEE Std 802.15.4 specifications section
   REFERENCE
                   7.3.1.1.2"
   ::= { lowpanObjects 2 }
lowpanRoutingTable OBJECT-TYPE
   SYNTAX
                   SEQUENCE OF LowpanRoutingEntry
   MAX-ACCESS
                   not-accessible
   STATUS
                   current
                   "The routing table entries of a device."
   DESCRIPTION
   ::= { lowpanObjects 3 }
lowpanRoutingEntry OBJECT-TYPE
   SYNTAX
                   LowpanRoutingEntry
   MAX-ACCESS
                   not-accessible
   STATUS
                   current
                   "This entry represents a conceptual row in the
   DESCRIPTION
                   routing table. It represents a single routing
                   entry."
                   lowpanRouteDestAddress }
   INDEX
   ::= { lowpanRoutingTable 1 }
LowpanRoutingEntry ::= SEQUENCE {
   lowpanRouteDestAddress LowpanShortAddress,
   lowpanRouteNextHopAddress LowpanShortAddress,
   lowpanRouteProtocol INTEGER
   }
```

```
lowpanRouteDestAddress
                         OBJECT-TYPE
   SYNTAX
                   LowpanShortAddress
   MAX-ACCESS
                   not-accessible
   STATUS
                   current
   DESCRIPTION
                   "The 16-bit short address of destination of this
                   route."
   ::= { lowpanRoutingEntry 1 }
lowpanRouteNextHopAddress
                            OBJECT-TYPE
   SYNTAX
                   LowpanShortAddress
   MAX-ACCESS
                   read-only
                   current
   STATUS
   DESCRIPTION
                   "The short address of the next hop which leads
                   to the destination."
   ::= { lowpanRoutingEntry 2 }
lowpanRouteProtocol
                      OBJECT-TYPE
   SYNTAX
                     INTEGER { other ( 0 ), dymoLow ( 1 ), hiLow
                    (2), load(3)}
   MAX-ACCESS
                   read-only
   STATUS
                   current
   DESCRIPTION
                   "6lowpan currently supports three routing
                   protocols
                   dymoLow(1) - Dynamic MANET On-demand routing
                   for 6LoWPAN
                   hiLow(2) - Hierarchical Routing over 6LoWPAN
                   load(3) -Ad Hoc On-Demand Distance Vector
                   Routing for 6lowpan"
   REFERENCE
                   "IETF 6lowpan WG
                   draft-daniel-6lowpan-load-adhoc-routing
                   (Work in progress), IETF 6lowpan WG
                   draft-montenegro-6lowpan-dymo-low-routing
                   (Work in progress), IETF 6lowpan WG
                   draft-daniel-6lowpan-hilow-hierarchical-routing
                    (Work in progress)"
   ::= { lowpanRoutingEntry 3 }
lowpanNeighborTable
                     OBJECT-TYPE
   SYNTAX
                     SEQUENCE OF LowpanNeighborEntry
   MAX-ACCESS
                     not-accessible
   STATUS
                     current
   DESCRIPTION
                     "The neighbor table entries of a device"
   ::= { lowpanObjects 4 }
lowpanNeighborEntry
                     OBJECT-TYPE
   SYNTAX
                     LowpanNeighborEntry
```

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```
Internet-Draft
```

```
not-accessible
   MAX-ACCESS
   STATUS
                     current
                     "This entry represents a conceptual row in the
   DESCRIPTION
                     neighbor table. It represents a single
                      neighbor table entry."
   INDEX
                { lowpanNeighborEUI64Address }
   ::= { lowpanNeighborTable 1 }
LowpanNeighborEntry ::= SEQUENCE {
   lowpanNeighborPanID Unsigned32,
   lowpanNeighborEUI64Address LowpanIEEEEUI64Address,
   lowpanNeighborShortAddress LowpanShortAddress,
   lowpanNeighborDeviceType INTEGER,
   lowpanNeighborIsParent TruthValue
lowpanNeighborPanID
                      OBJECT-TYPE
   SYNTAX
                     Unsigned32 (0..65536)
   MAX-ACCESS
                     read-only
   STATUS
                     current
                      "The Personal area network Identifier
   DESCRIPTION
                      (PanID) of the neighbor entry."
   ::= { lowpanNeighborEntry 1 }
lowpanNeighborEUI64Address
                             OBJECT-TYPE
   SYNTAX
                     LowpanIEEEEUI64Address
   MAX-ACCESS
                     not-accessible
   STATUS
                     current
                     "The EUI64 bit address of the neighbor entry."
   DESCRIPTION
   ::= { lowpanNeighborEntry 2 }
lowpanNeighborShortAddress
                             OBJECT-TYPE
   SYNTAX
                     LowpanShortAddress
   MAX-ACCESS
                     read-only
   STATUS
                     current
                  "The 16-bit short address of the neighbor entry."
   DESCRIPTION
   ::= { lowpanNeighborEntry 3 }
lowpanNeighborDeviceType
                           OBJECT-TYPE
   SYNTAX
                      INTEGER { coordinator ( 0 ) , router ( 1 ) ,
                     endDevice ( 2 )}
                     read-only
   MAX-ACCESS
   STATUS
                     current
                      "The device type of the neighbor entry."
   DESCRIPTION
   ::= { lowpanNeighborEntry 4 }
```

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```
lowpanNeighborIsParent
                          OBJECT-TYPE
   SYNTAX
                      TruthValue
   MAX-ACCESS
                      read-only
   STATUS
                      current
   DESCRIPTION
                       "The value 'true(1)' indicates that the
                       neighbor is a topological parent of the
                       device."
    ::= { lowpanNeighborEntry 5 }
lowpanUseHierarchicalRouting
                                OBJECT-TYPE
   SYNTAX
                      TruthValue
   MAX-ACCESS
                      read-only
   STATUS
                      current
   DESCRIPTION
                      "The value 'true(1)' indicates that the
                      entity uses tree based routing. 'false(2)'
                      indicates that entity is not using
                      tree based routing."
    ::= { lowpanObjects 5 }
lowpanBroadcastSequenceNumber
                                 OBJECT-TYPE
   SYNTAX
                      Unsigned32 (0..65536)
   MAX-ACCESS
                      read-only
   STATUS
                      current
   DESCRIPTION
                      "The last value of the sequence number
                      that was added to the 6lowpan broadcast or
                      multicast frame."
                      "Section 11 draft-ietf-6lowpan-format (work in
   REFERENCE
                      progress)"
    ::= { lowpanObjects 6 }
lowpanAckTimeout
                    OBJECT-TYPE
   SYNTAX
                      Unsigned32
                      "milli-seconds"
   UNITS
   MAX-ACCESS
                      read-write
   STATUS
                      current
                      "The maximum time allowed for retransmission
   DESCRIPTION
                       of a broadcast message"
    ::= { lowpanObjects 7 }
lowpanBroadcastRetries
                          OBJECT-TYPE
   SYNTAX
                      Unsigned32
   MAX-ACCESS
                      read-write
   STATUS
                      current
                      "The maximum number of retries allowed for a
   DESCRIPTION
                      broadcast message."
    ::= { lowpanObjects 8 }
```

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```
Internet-Draft
                   6lowpan Management Information Base
                                                               July 2008
       -- Conformance information
     lowpanGroups
                        OBJECT IDENTIFIER ::= { lowpanConformance 1 }
     lowpanCompliances OBJECT IDENTIFIER ::= { lowpanConformance 2 }
    lowpanGeneralGroup
                          OBJECT-GROUP
       OBJECTS
                        { lowpanDeviceCapabilities , lowpanDeviceRole,
                        lowpanUseHierarchicalRouting,
                        lowpanAckTimeout, lowpanBroadcastRetries,
                        lowpanBroadcastSequenceNumber,
                        lowpanNeighborDeviceType,
                        lowpanNeighborPanID,
                        lowpanNeighborIsParent,
                        lowpanNeighborShortAddress,
                        lowpanRouteNextHopAddress,
                        lowpanRouteProtocol }
                        current
       STATUS
                        "A collection of objects for basic 6lowpan
       DESCRIPTION
                        monitoring"
        ::= { lowpanGroups 1 }
    lowpanCoreCompliance
                            MODULE-COMPLIANCE
       STATUS
                          current
       DESCRIPTION
                        "The compliance statement for SNMP entities
                        which implement the LOWPAN-MIB."
       MODULE -- this module
              MANDATORY-GROUPS { lowpanGeneralGroup }
        ::= { lowpanCompliances 1 }
     lowpanCoreReadOnlyCompliance MODULE-COMPLIANCE
           STATUS current
           DESCRIPTION
                  "The compliance statement for SNMP entities
                  which implement the LOWPAN-MIB without support
                   for read-write (i.e. in read-only mode) .
           MODULE -- this module
              MANDATORY-GROUPS { lowpanGeneralGroup }
                       lowpanAckTimeout
           OBJECT
           MIN-ACCESS read-only
           DESCRIPTION
```

"Write access is not required."

OBJECT 10 MIN-ACCESS read-only

DESCRIPTION

lowpanBroadcastRetries

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```
"Write access is not required."
::= { lowpanCompliances 2 }
```

**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 objects and their sensitivity/vulnerability:

- o The vulnerabilities for lowpanAckTimeout object will be discussed in the next version of the draft.
- o The vulnerabilities for lowpanBroadcastRetries object will be discussed in the next version of the draft.

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. The vulnerabilities will be discussed in next versions on this draft

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

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the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

### 8. IANA Considerations

The MIB module in this document uses the following IANA-assigned OBJECT IDENTIFIER values recorded in the SMI Numbers registry:

Descriptor	0BJECT	IDENTIFIER	value
lowpanTCMIB lowpanMIB		,	

## 9. Contributors

Thanks to the contribution from 6lowpan WG MIB Doctor, Juergen Schoenwaelder for the review and useful discussion for writing this document

## 10. Acknowledgements

Thanks to Ali Hammad, Shafique Ahmed Choadry, Won-Do Jung, Kang Myo Kim, Chae-seong Lim and Geoff Mulligan for their useful discussion and support for writing this document and Glenn M. Keeni for reviewing the MIB module.

# 11. References

### 11.1. Normative References

[RFC2119]	Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", <u>BCP 14</u> , <u>RFC 2119</u> , 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

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for SMIv2", STD 58, RFC 2580, April 1999.

[IEEE802.15.4]

802.15.4-2003, IEEE Standard., "Wireless medium access control and physical layer specifications for low-rate wireless personal area networks.", May 2003.

[RFC4944]

N., Kushalnagar., Montenegro, G., Hui, J., and D. Culler, "6LoWPAN: Transmission of IPv6 Packets over IEEE 802.15.4 Networks", RFC 4944, September 2007.

### 11.2. Informative References

[RFC3410]

Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", <u>RFC 3410</u>, December 2002.

[EUI64]

802.15.4-2003, IEEE Standard.,
"GUIDELINES FOR 64-BIT GLOBAL IDENTIFIER
(EUI-64) REGISTRATION AUTHORITY".

[RFC4919]

N., Kushalnagar., Montenegro, G., and C. Schumacher, "6LoWPAN: Overview, Assumptions, Problem Statement and Goals", RFC 4919, August 2007.

## [I-D.montenegro-6lowpan-dymo-low-routing]

Kim, K., Montenegro, G., Daniel Park, S., Chakeres, I., and S. Yoo, "Dynamic MANET On-demand for 6LoWPAN (DYMO-low)
Routing", draft-montenegro-6lowpan-dymo-low-routing (work in progress), October 2005.

### [I-D.daniel-6lowpan-hilow-hierarchical-routing]

Kim, K., Yoo, S., Park, J., Daniel Park, S., and J. Lee, "Hierarchical Routing over 6LoWPAN (HiLow)", draft-daniel-6lowpan-hilow-hierarchical-routing (work in progress), July 2005.

[I-D.daniel-6lowpan-load-adhoc-routing]

Kim, K., Daniel Park, S., Montenegro, G., Yoo, S., and Kushalnagar. N., "6LoWPAN Ad Hoc On-Demand Distance Vector Routing (LOAD)", <a href="mailto:draft-daniel-6lowpan-load-adhoc-routing">draft-daniel-6lowpan-load-adhoc-routing</a> (work in progress), March 2006.

#### Appendix A. Open Issues

For transmission over 802.15.4 only 33 bytes are available for application data using UDP in the worst case. Therefore compression mechanisms for SNMP packets are required. Furthermore SNMP based access to 802.15.4 PHY/MAC PIBs should also be provided by assigning them standard SNMP object identifiers.

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