Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: January 15, 2009

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July 14, 2008

6lowpan Management Information Base

draft-daniel-lowpan-mib-01.txt

Status of This Memo

Copyright Notice

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.

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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 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

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 [RFC2578], SNMPv2-TC [RFC2579] and SNMPv2-CONF [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"
        ORGANIZATION    "IETF 6lowpan Working Group"
        CONTACT-INFO    "Ki-Hyung Kim, Editor
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```
      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"
        CONTACT-INFO    "Ki-Hyung Kim, Editor
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```
      DESCRIPTION     "The MIB module for monitoring 6lowpan
                      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

     lowpanNotifications        OBJECT IDENTIFIER ::= { lowpanMIB 0 }
     lowpanObjects              OBJECT IDENTIFIER ::= { lowpanMIB 1 }
     lowpanConformance          OBJECT IDENTIFIER ::= { lowpanMIB 2 }

  lowpanDeviceRole    OBJECT-TYPE
```

```
        SYNTAX            INTEGER  { coordinator ( 0 ) , router ( 1 ) ,
                        endDevice ( 2 ) }
        MAX-ACCESS          read-only
        STATUS              current
        DESCRIPTION     "The device in 6lowpan can play three roles.
                        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.
```

```
                    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."
        REFERENCE   "IEEE Std 802.15.4 specifications section
                    7.3.1.1.2"
        ::=  {  lowpanObjects  2  }


    lowpanRoutingTable  OBJECT-TYPE
        SYNTAX          SEQUENCE  OF  LowpanRoutingEntry
        MAX-ACCESS      not-accessible
        STATUS          current
        DESCRIPTION     "The routing table entries of a device."
        ::=  { lowpanObjects  3 }

    lowpanRoutingEntry  OBJECT-TYPE
        SYNTAX          LowpanRoutingEntry
        MAX-ACCESS      not-accessible
        STATUS          current
        DESCRIPTION     "This entry represents a conceptual row in the
                        routing table.  It represents a single routing
                        entry."
        INDEX        {  lowpanRouteDestAddress  }
        ::=  { 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
        STATUS          current
        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
```

```
        MAX-ACCESS        not-accessible
        STATUS            current
        DESCRIPTION       "This entry represents a conceptual row in the
                          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
        DESCRIPTION        "The Personal area network Identifier
                           (PanID) of the neighbor entry."
        ::=  {  lowpanNeighborEntry  1  }


    lowpanNeighborEUI64Address    OBJECT-TYPE
        SYNTAX            LowpanIEEEEUI64Address
        MAX-ACCESS        not-accessible
        STATUS            current
        DESCRIPTION       "The EUI64 bit address of the neighbor entry."
        ::=  {  lowpanNeighborEntry  2  }


    lowpanNeighborShortAddress    OBJECT-TYPE
        SYNTAX            LowpanShortAddress
        MAX-ACCESS        read-only
        STATUS            current
        DESCRIPTION    "The 16-bit short address of the neighbor entry."
        ::=  {  lowpanNeighborEntry  3  }


    lowpanNeighborDeviceType    OBJECT-TYPE
        SYNTAX            INTEGER  { coordinator ( 0 ) , router ( 1 ) ,
                          endDevice ( 2 )}
        MAX-ACCESS        read-only
        STATUS            current
        DESCRIPTION        "The device type of the neighbor entry."
        ::=  {  lowpanNeighborEntry  4  }
```

```
    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."
        REFERENCE         "Section 11 draft-ietf-6lowpan-format (work in
                          progress)"
        ::=  {  lowpanObjects  6  }

    lowpanAckTimeout    OBJECT-TYPE
        SYNTAX            Unsigned32
        UNITS             "milli-seconds"
        MAX-ACCESS        read-write
        STATUS            current
        DESCRIPTION       "The maximum time allowed for retransmission
                           of a broadcast message"
        ::=  {  lowpanObjects  7  }

    lowpanBroadcastRetries    OBJECT-TYPE
        SYNTAX            Unsigned32
        MAX-ACCESS        read-write
        STATUS            current
        DESCRIPTION       "The maximum number of retries allowed for a
                          broadcast message."
        ::=  {  lowpanObjects  8  }
```

```
       -- 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 }
        STATUS          current
        DESCRIPTION     "A collection of objects for basic 6lowpan
                        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 }

           OBJECT      lowpanAckTimeout
           MIN-ACCESS  read-only
           DESCRIPTION
                  "Write access is not required."

                   OBJECT      lowpanBroadcastRetries
           MIN-ACCESS  read-only
           DESCRIPTION
```

```
                    "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:

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

- 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

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	OBJECT IDENTIFIER value
lowpanTCMIB	{ mib-2 XXX }
lowpanMIB	{ mib-2 YYY }

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

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Kim, K., Daniel Park, S., Montenegro, G., Yoo, S., and Kushalnagar. N., "6LoWPAN Ad Hoc On-Demand Distance Vector Routing (LOAD)", draft-daniel-6lowpan-load-adhoc-routing (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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Acknowledgement

Funding for the RFC Editor function is provided by the IETF Administrative Support Activity (IASA).