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                                 October 26, 2009

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**6LowPAN Management Information Base  
draft-daniel-6lowpan-mib-01.txt**

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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.

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## 1. Introduction

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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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## 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](#)] (Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework," December 2002.).

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 compliant to the SMIV2, which is described in STD 58, RFC 2578 [[RFC2578](#)] (McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIV2)," April 1999.), STD 58, RFC 2579 [[RFC2579](#)] (McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIV2," April 1999.) and STD 58, RFC 2580 [[RFC2580](#)] (McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIV2," April 1999.).

## 3. Conventions

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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](#)] (Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels," March 1997.).

## 4. Overview

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

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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

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Some management objects defined in other MIB modules are applicable to an entity implementing this MIB. In particular, it is assumed that an entity implementing the 6LoWPAN-MIB module will also implement the 'system' group of the SNMPv2-MIB [[RFC3418](#)] ([Presuhn, R., "Management Information Base \(MIB\) for the Simple Network Management Protocol \(SNMP\)," December 2002.](#)) and the 'interfaces' group of the IF-MIB [[RFC2863](#)] ([McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB," June 2000.](#)). The description of how certain objects in the IF-MIB are used is TBD.

### 5.1. Relationship to the SNMPv2-MIB

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The 'system' group in the SNMPv2-MIB [[RFC3418](#)] ([Presuhn, R., "Management Information Base \(MIB\) for the Simple Network Management Protocol \(SNMP\)," December 2002.](#)) is defined as being mandatory for all systems, and the objects apply to the entity as a whole. The 'system' group provides identification of the management entity and certain other system-wide data. The 6LoWPAN-MIB does not duplicate those objects.

### 5.2. MIB modules required for IMPORTS

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The following MIB module IMPORTS objects from SNMPv2-SMI [[RFC2578](#)] ([McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 \(SMIV2\)," April 1999.](#)), SNMPv2-TC [[RFC2579](#)] ([McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIV2," April 1999.](#)) and SNMPv2-CONF [[RFC2580](#)] ([McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIV2," April 1999.](#))

## 6. Definitions

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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 "200909260012Z"

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Email: soohong.park@samsung.com

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 Internet Society 2007. 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 "200909260012Z"

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.

LowpanIEEEEEEUI64Address ::= 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

```
6LOWPAN-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;
```

```
6lowpanMIB MODULE-IDENTITY  
  LAST-UPDATED "200909260012Z"  
  ORGANIZATION "IETF 6LoWPAN Working Group"  
  CONTACT-INFO "Ki-Hyung Kim  
  picosNet Corp/Ajou Univ.  
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DESCRIPTION "The MIB module for monitoring 6LoWPAN  
entities.

Copyright (C) The Internet Society 2007. 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 "200909260012Z"

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 { PAN Coordinator ( 0 ) , 6LoWPAN
                             Router ( 1 ) , 6LoWPAN Mesh Node ( 3 ) ,
                             6LoWPAN Host ( 2 ) }

  MAX-ACCESS               read-only
  STATUS                   current
  DESCRIPTION              "The device in 6LoWPAN can play four roles.
                           coordinator(0) indicates that the device is a
                           PAN Coordinator which is the primary controller
                           of the PAN. It MAY initiate the synchronization
                           of the entire 6LoWPAN by transmitting beacons.
                           6LoWPAN Router(1) A LoWPAN node that forwards
                           datagrams between arbitrary source- destination
                           pairs using a single 6LoWPAN interface
                           performing IP routing on that interface.
                           6LoWPAN Mesh Node (2) A LoWPAN node that
                           forwards data between arbitrary source-
                           destination pairs using link addresses (and
                           thus only exist in Mesh Under LoWPANs).
                           6LoWPAN Host(3) indicates a node that only
                           sources or sinks IPv6 datagrams.

                           ::= { lowpanObjects 1 }
```

```
lowpanDeviceCapabilities OBJECT-TYPE
  SYNTAX                  BITS { alternatePANcoordinator ( 0 ) ,
                             deviceType ( 1 ) , powerSource ( 2 ) ,
                             receiverOnWhenIdle ( 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 }

lowpanRoutingProtocol OBJECT-TYPE  
SYNTAX INTEGER { RPL ( 0 ), DADR ( 1 ), DV ( 2 ),  
dymoLow ( 3 ), hiLow ( 4 ) , load ( 5 ), Other  
Other ( 6 ) }  
MAX-ACCESS read-only  
STATUS current  
DESCRIPTION "6LoWPAN Router Over and Mesh Under currently  
have three protocols each.  
RPL(0) - Routing Protocol for Low Power and  
Lossy Networks  
DADR (1)- Distributed Autonomous Depth-first  
Routing Protocol in LLN

DV (2)- A Distance Vector Protocol for Routing Over Low Power and Lossy Networks

dymoLow(3) - Dynamic MANET On-demand routing for 6LoWPAN

hiLow(4) - Hierarchical Routing over 6LoWPAN

load(5) -Ad Hoc On-Demand Distance Vector Routing for 6LoWPAN"

REFERENCE "draft-ietf-roll-rpl (Work in progress),  
draft-iwao-roll-dadr (Work in progress),  
draft-goyal-roll-dv (Work in progress),  
draft-daniel-6lowpan-load-adhoc-routing  
(Work in progress),  
draft-montenegro-6lowpan-dymo-low-routing  
(Work in progress),  
draft-daniel-6lowpan-hilow-hierarchical-routing  
(Work in progress)"

::= { lowpanObjects 3 }

lowpanRoutingTable OBJECT-TYPE  
SYNTAX SEQUENCE OF LowpanRoutingEntry  
MAX-ACCESS not-accessible  
STATUS current  
DESCRIPTION "The routing table entries of a device"  
::= { lowpanObjects 4 }

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,  
}

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 }

lowpanNeighborTable         OBJECT-TYPE
    SYNTAX                    SEQUENCE OF LowpanNeighborEntry
    MAX-ACCESS                 not-accessible
    STATUS                     current
    DESCRIPTION                "The neighbor table entries of a device"
    ::= { lowpanObjects 5 }

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 6 }
```

```
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 "RFC4944"  
::= { lowpanObjects 7 }
```

```

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 8 }

lowpanBroadcastRetries OBJECT-TYPE
    SYNTAX              Unsigned32
    MAX-ACCESS          read-write
    STATUS              current
    DESCRIPTION         "The maximum number of retries allowed for a
                        broadcast message."
    ::= { lowpanObjects 9 }

-- Conformance information
lowpanGroups          OBJECT IDENTIFIER ::= { lowpanConformance 1 }
lowpanCompliances     OBJECT IDENTIFIER ::= { lowpanConformance 2 }

lowpanGeneralGroup    OBJECT-GROUP
    OBJECTS            { lowpanDeviceCapabilities,
                        lowpanRouteNextHopAddress,
                        lowpanRouteNextHopAddress,
                        lowpanRoutingProtocol}
    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

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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 [\[RFC3410\] \(Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework," December 2002.\)](#), 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

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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

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

## 10. Acknowledgements

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Thanks to Ali Hammad Akbar, Shafique Ahmed Choadry, Chae-Seong Lim, Seong-Soon Joo, and Geoff Mulligan for their useful discussion and support for writing this document and to Glenn M. Keeni for reviewing the MIB module.

## 11. References

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## 11.1. Normative References

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- [RFC2119] [Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels,"](#) BCP 14, RFC 2119, March 1997 ([TXT](#), [HTML](#), [XML](#)).
- [RFC2578] [McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 \(SMIV2\),"](#) STD 58, RFC 2578, April 1999 ([TXT](#)).
- [RFC2579] [McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIV2,"](#) STD 58, RFC 2579, April 1999 ([TXT](#)).
- [RFC2580] [McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIV2,"](#) STD 58, RFC 2580, April 1999 ([TXT](#)).
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## Appendix A. Open Issues

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SNMP based access to 802.15.4 PHY/MAC PIBs should also be provided by assigning them object identifiers.

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