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J. Schoenwaelder
A. Sehgal
Jacobs University
T. Tsou
Huawei Technologies (USA)
C. Zhou
Huawei Technologies
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Definition of Managed Objects for IPv6 over Low-Power Wireless Personal
Area Networks (6LoWPANs)

[draft-ietf-6lo-lowpan-mib-02](http://datatracker.ietf.org/drafts/current/draft-ietf-6lo-lowpan-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 IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs).

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LOWPAN-MIB

July 2014

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Table of Contents

1.	Introduction	2
2.	The Internet-Standard Management Framework	2
3.	Conventions	3
4.	Overview	3
5.	Relationship to Other MIB Modules	7
6.	Definitions	7
7.	Security Considerations	24
8.	IANA Considerations	24
9.	Acknowledgements	25
10.	References	25
10.1.	Normative References	25
10.2.	Informative References	25

[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 IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs) [[RFC4944](#)].

While a MIB module provides a direct binding for accessing data via the Simple Network Management Protocol (SNMP) [[RFC3410](#)], supporting SNMP may not always be affordable on constrained devices. Other protocols to access data modeled in MIB modules are possible and proposals have been made recently to provide bindings to the Constrained Application Protocol (CoAP) [[RFC7252](#)].

[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 left part of Figure 1 provides an overview of the protocols typically used on constrained devices. The right part lists the MIB modules providing monitoring and troubleshooting support ([RFC2013](#), [RFC4292](#), [RFC4293](#), [RFC2863](#)). The LOWPAN-MIB defined in this document fills a hole by providing monitoring and troubleshooting support for the 6LoWPAN layer.

Protocol Layer	MIB Modules
CoAP	
UDP	UDP-MIB [RFC2013]
IPv6	IP-MIB [RFC4293]
ICMPv6	IP-FORWARD-MIB [RFC4292]
6LoWPAN	LOWPAN-MIB [RFCXXXX]
	IF-MIB [RFC2863]
IEEE 802.15.4	

Figure 1: Protocol Layers and MIB Modules

The LOWPAN-MIB module is primarily a collection of counters that reflect how 6LoWPAN datagrams are processed by the 6LoWPAN layer. The objects are defined twice, once to report the global statistics

as seen by the 6LoWPAN layer and once to report per interface 6LoWPAN layer statistics. The per interface statistics are optional to implement. The object identifier registration tree has the following structure:

```
---- lowpanMIB(1.3.6.1.2.1.XXXX)
  +---- lowpanNotifications(0)
  +---- lowpanObjects(1)
    | +---- lowpanStats(1)
    |   | +---r- lowpanReasmTimeout(1)           Unsigned32
    |   | +---r- lowpanInReceives(2)           Counter32
    |   | +---r- lowpanInHdrErrors(3)          Counter32
```

```
    |   | +---r- lowpanInMeshReceives(4)         Counter32
    |   | +---r- lowpanInMeshForwds(5)         Counter32
    |   | +---r- lowpanInMeshDelivers(6)       Counter32
    |   | +---r- lowpanInReasmReqds(7)         Counter32
    |   | +---r- lowpanInReasmFails(8)         Counter32
    |   | +---r- lowpanInReasmOKs(9)           Counter32
    |   | +---r- lowpanInCompReqds(10)         Counter32
    |   | +---r- lowpanInCompFails(11)         Counter32
    |   | +---r- lowpanInCompOKs(12)          Counter32
    |   | +---r- lowpanInDiscards(13)          Counter32
    |   | +---r- lowpanInDelivers(14)          Counter32
    |   | +---r- lowpanOutRequests(15)          Counter32
    |   | +---r- lowpanOutCompReqds(16)        Counter32
    |   | +---r- lowpanOutCompFails(17)        Counter32
    |   | +---r- lowpanOutCompOKs(18)          Counter32
    |   | +---r- lowpanOutFragReqds(19)        Counter32
    |   | +---r- lowpanOutFragFails(20)        Counter32
    |   | +---r- lowpanOutFragOKs(21)          Counter32
    |   | +---r- lowpanOutFragCreates(22)       Counter32
    |   | +---r- lowpanOutMeshHopLimitExceeds(23) Counter32
    |   | +---r- lowpanOutMeshNoRoutes(24)     Counter32
    |   | +---r- lowpanOutMeshRequests(25)     Counter32
    |   | +---r- lowpanOutMeshForwds(26)       Counter32
    |   | +---r- lowpanOutMeshTransmits(27)    Counter32
    |   | +---r- lowpanOutDiscards(28)         Counter32
    |   | +---r- lowpanOutTransmits(29)        Counter32
    |   +---- lowpanIfStatsTable(2)
    |     +---- lowpanIfStatsEntry(1) [ifIndex]
    |       +---r- lowpanIfReasmTimeout(1)     Unsigned32
```

```

|         +---r- lowpanIfInReceives(2)           Counter32
|         +---r- lowpanIfInHdrErrors(3)         Counter32
|         +---r- lowpanIfInMeshReceives(4)      Counter32
|         +---r- lowpanIfInMeshForwds(5)        Counter32
|         +---r- lowpanIfInMeshDelivers(6)      Counter32
|         +---r- lowpanIfInReasmReqds(7)        Counter32
|         +---r- lowpanIfInReasmFails(8)        Counter32
|         +---r- lowpanIfInReasmOKs(9)          Counter32
|         +---r- lowpanIfInCompReqds(10)        Counter32
|         +---r- lowpanIfInCompFails(11)        Counter32
|         +---r- lowpanIfInCompOKs(12)          Counter32
|         +---r- lowpanIfInDiscards(13)         Counter32
|         +---r- lowpanIfInDelivers(14)         Counter32
|         +---r- lowpanIfOutRequests(15)        Counter32
|         +---r- lowpanIfOutCompReqds(16)       Counter32
|         +---r- lowpanIfOutCompFails(17)       Counter32
|         +---r- lowpanIfOutCompOKs(18)        Counter32
|         +---r- lowpanIfOutFragReqds(19)       Counter32
|         +---r- lowpanIfOutFragFails(20)       Counter32

```

```

|         +---r- lowpanIfOutFragOKs(21)         Counter32
|         +---r- lowpanIfOutFragCreates(22)     Counter32
|         +---r- lowpanIfOutMeshHopLimitExceeds(23) Counter32
|         +---r- lowpanIfOutMeshNoRoutes(24)    Counter32
|         +---r- lowpanIfOutMeshRequests(25)    Counter32
|         +---r- lowpanIfOutMeshForwds(26)      Counter32
|         +---r- lowpanIfOutMeshTransmits(27)   Counter32
|         +---r- lowpanIfOutDiscards(28)        Counter32
|         +---r- lowpanIfOutTransmits(29)       Counter32
+----- lowpanConformance(2)
  +----- lowpanGroups(1)
    | +----- lowpanStatsGroup(1)
    | +----- lowpanStatsMeshGroup(2)
    | +----- lowpanIfStatsGroup(3)
    | +----- lowpanIfStatsMeshGroup(4)
  +----- lowpanCompliances(2)
    +----- lowpanCompliance(1)

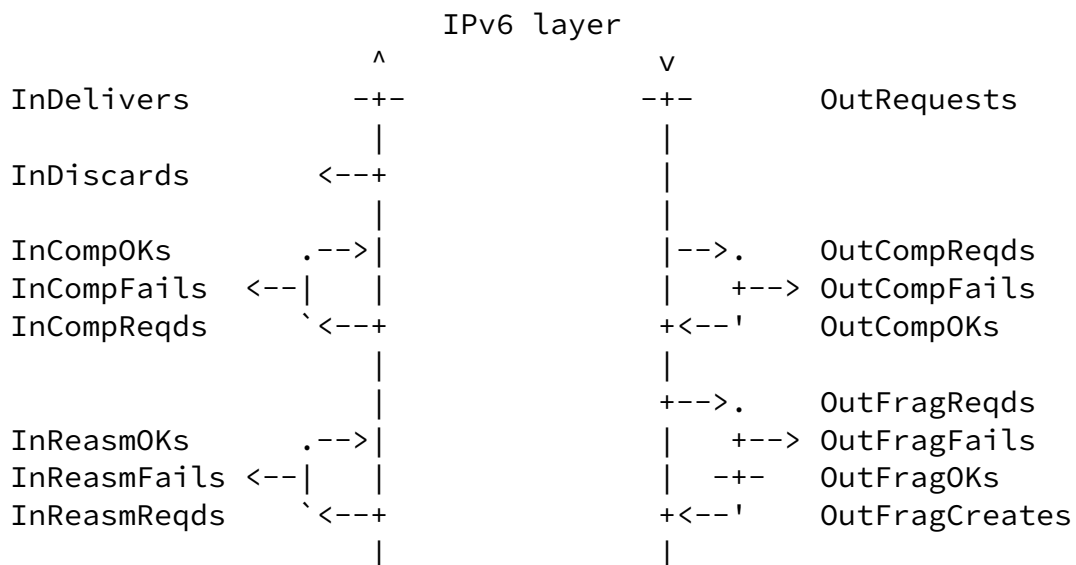
```

The counters defined in the LOWPAN-MIB module provide information about the 6LoWPAN datagrams received and transmitted and how they are processed in the 6LoWPAN layer. For link-layers that use the 6LoWPAN dispatch byte as defined in [[RFC4944](#)] (e.g., IEEE 802.15.4), a

6LoWPAN datagram is a datagram with a dispatch byte matching the bit patterns 01xxxxxx, 10xxxxxx, or 11xxxxxx. Datagrams with a dispatch byte matching the bit pattern 00xxxxxx (NALP - not a LoWPAN frame) are not considered to be 6LoWPAN datagram by this specification. Other radio technologies may use different mechanisms to identify 6LoWPAN datagrams (e.g., the BLUETOOTH Low Energy Logical Link Control and Adaptation Protocol uses Channel Identifiers [[I-D.ietf-6lo-btle](#)]).

Figure 2 illustrates the conceptual relationships between the counters. Implementations may choose to implement the processing of 6LoWPAN datagrams in a different order.

The generic InDiscards and OutDiscards counters can be incremented anytime when 6LoWPAN datagrams are discarded due to reasons not covered by the other more specific counters. For example, an implementation discarding 6LoWPAN datagrams while all buffers are used for ongoing packet reassemblies will increment the relevant InDiscards counters for each discarded 6LoWPAN datagram.



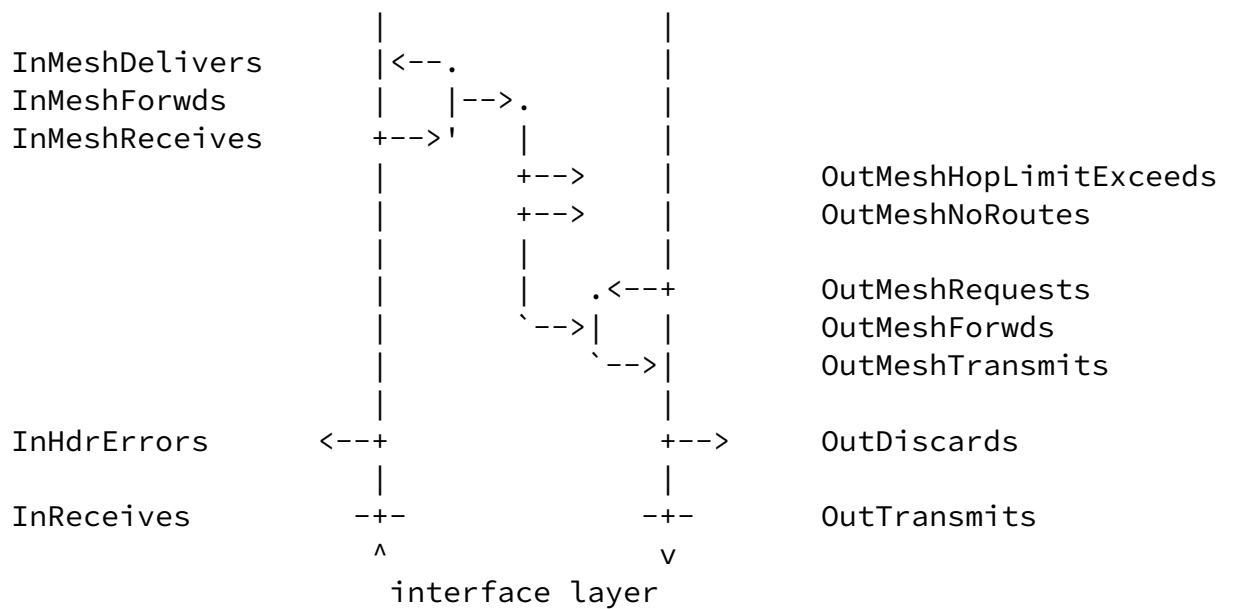


Figure 2: Conceptual Relationship between LOWPAN-MIB Counters

The fragmentation related counters have been modeled after the fragmentation related counters of the IP-MIB [RFC4293]. The discard counters have been placed at the end of the input and output chains but they can be bumped any time if a datagram is discarded for a reason not covered by the other counters.

The compression related counters provide insights into compression requests and in particular also compression related failures. Note that the diagram is conceptual in the sense that compression happens after reassembly for incoming 6LoWPAN datagrams and compression happens before fragmentation for outgoing 6LoWPAN datagrams. Implementations may choose to implement things slightly differently. For example, implementations may decompress FRAG1 fragments as soon as they are received, not waiting for reassembly to complete.

The mesh header processing related counters do not have an explicit discard counter. Implementations that do not support mesh forwarding MUST count the number of received 6LoWPAN datagrams with a MESH header (lowpanInMeshReceives) but they MUST NOT increment the lowpanInMeshReceives and lowpanInMeshDelivers counters if these 6LoWPAN datagrams are dropped.

5. Relationship to Other MIB Modules

The MIB module IMPORTS definitions from SNMPv2-SMI [[RFC2578](#)], SNMPv2-CONF [[RFC2580](#)], and IF-MIB [[RFC2863](#)].

6. Definitions

```
LOWPAN-MIB DEFINITIONS ::= BEGIN
```

```
IMPORTS
```

```
    MODULE-IDENTITY, OBJECT-TYPE, Unsigned32, Counter32, mib-2
        FROM SNMPv2-SMI                                -- RFC 2578
    OBJECT-GROUP, MODULE-COMPLIANCE
        FROM SNMPv2-CONF                                -- RFC 2580
    ifIndex FROM IF-MIB;                                -- RFC 2863
```

```
lowpanMIB     MODULE-IDENTITY
```

```
    LAST-UPDATED      "201407250000Z"
```

```
    ORGANIZATION
```

```
        "Jacobs University Bremen"
```

```
    CONTACT-INFO
```

```
        "Juergen Schoenwaelder
```

```
        Jacobs University Bremen
```

```
        Email: j.schoenwaelder@jacobs-university.de
```

```
        Anuj Sehgal
```

```
        Jacobs University Bremen
```

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

```
        Tina Tsou
```

```
        Huawei Technologies
```

```
        Email: tina.tsou.zouting@huawei.com
```

```
        Cathy Zhou
```

```
        Huawei Technologies
```

```
        Email: cathyzhou@huawei.com"
```

```
DESCRIPTION
```

```
"The MIB module for monitoring nodes implementing the IPv6
over Low-Power Wireless Personal Area Networks (6LoWPAN)
protocol."
```


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```
REVISION "201407250000Z"
DESCRIPTION
    "Initial version, published as RFC XXXX."
-- RFC Ed.: replace XXXX with RFC number and remove this note

 ::= { mib-2 XXXX }

-- object definitions

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

lowpanStats              OBJECT IDENTIFIER ::= { lowpanObjects 1 }

lowpanReasmTimeout OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS       "seconds"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The maximum number of seconds that received fragments are
         held while they are awaiting reassembly at this entity."
    ::= { lowpanStats 1 }

lowpanInReceives OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The total number of 6LoWPAN datagrams received, including
         those received in error."
    ::= { lowpanStats 2 }

lowpanInHdrErrors OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
```

DESCRIPTION

"The number of received 6LoWPAN datagrams discarded due to errors in their headers, including unknown dispatch values."

::= { lowpanStats 3 }

lowpanInMeshReceives OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of received 6LoWPAN datagrams with a MESH header."

::= { lowpanStats 4 }

lowpanInMeshForwds OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of received 6LoWPAN datagrams requiring MESH forwarding."

::= { lowpanStats 5 }

lowpanInMeshDelivers OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of received 6LoWPAN datagrams with a MESH header delivered to the local system."

::= { lowpanStats 6 }

lowpanInReasmReqds OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of received 6LoWPAN fragments that needed to be reassembled. This includes both FRAG1 and FRAGN 6LoWPAN datagrams."

::= { lowpanStats 7 }

lowpanInReasmFails OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of failures detected by the re-assembly

algorithm (e.g., timeouts). Note that this is not necessarily a count of discarded 6LoWPAN fragments since implementations can lose track of the number of fragments by combining them as received."

::= { lowpanStats 8 }

lowpanInReasmOKs OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of IPv6 packets successfully reassembled."

::= { lowpanStats 9 }

lowpanInCompReqs OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of 6LoWPAN datagrams requiring header decompression."

::= { lowpanStats 10 }

lowpanInCompFails OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of 6LoWPAN datagrams where header decompression failed (e.g., because the necessary context information was not available)."

::= { lowpanStats 11 }

lowpanInCompOKs OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of 6LoWPAN datagrams where header decompression

```
        was successful."
 ::= { lowpanStats 12 }
```

lowpanInDiscards OBJECT-TYPE

```
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
```

```
"The number of received 6LoWPAN datagrams for which no
```

```
problems were encountered to prevent their continued
processing, but were discarded (e.g., for lack of buffer
space). Note that this counter does not include any
datagrams discarded due to a reassembly failure or a
compression failure."
```

```
 ::= { lowpanStats 13 }
```

lowpanInDelivers OBJECT-TYPE

```
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
```

```
"The total number of IPv6 packets successfully delivered
to the IPv6 layer."
```

```
 ::= { lowpanStats 14 }
```

lowpanOutRequests OBJECT-TYPE

```
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
```

```
"The total number of IPv6 packets supplied by the IPv6
layer."
```

```
 ::= { lowpanStats 15 }
```

lowpanOutCompReqds OBJECT-TYPE

```
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
```

```
"The total number of IPv6 packets for which header
compression was attempted."
```

```
::= { lowpanStats 16 }
```

```
lowpanOutCompFails OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The total number of IPv6 packets for which header  
compression failed."
```

```
::= { lowpanStats 17 }
```

```
lowpanOutCompOKs OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The total number of IPv6 packets for which header  
compression was successful."
```

```
::= { lowpanStats 18 }
```

```
lowpanOutFragReqds OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The number of IPv6 packets that required fragmentation  
in order to be transmitted."
```

```
::= { lowpanStats 19 }
```

```
lowpanOutFragFails OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The number of IPv6 packets that have been discarded because  
fragmentation failed."
```

```
::= { lowpanStats 20 }
```

```
lowpanOutFragOKs OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

STATUS current
DESCRIPTION
"The number of IPv6 packets that have been successfully
fragmented."
::= { lowpanStats 21 }

lowpanOutFragCreates OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of 6LoWPAN fragments that have been
generated as a result of fragmentation. This includes
both FRAG1 and FRAGN 6LoWPAN datagrams."
::= { lowpanStats 22 }

lowpanOutMeshHopLimitExceeds OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of 6LoWPAN datagrams with a MESH header that
were dropped because the hop limit has been exceeded."

::= { lowpanStats 23 }

lowpanOutMeshNoRoutes OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of 6LoWPAN datagrams with a MESH header that
were dropped because there was no forwarding information
available."
::= { lowpanStats 24 }

lowpanOutMeshRequests OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of 6LoWPAN datagrams requiring MESH header

```
        encapsulation."  
 ::= { lowpanStats 25 }
```

lowpanOutMeshForwds OBJECT-TYPE

```
SYNTAX      Counter32  
MAX-ACCESS  read-only  
STATUS      current  
DESCRIPTION  
    "The number of 6LoWPAN datagrams with a MESH header for  
    which suitable forwarding information was available."  
 ::= { lowpanStats 26 }
```

lowpanOutMeshTransmits OBJECT-TYPE

```
SYNTAX      Counter32  
MAX-ACCESS  read-only  
STATUS      current  
DESCRIPTION  
    "The number of 6LoWPAN datagrams with a MESH header  
    created."  
 ::= { lowpanStats 27 }
```

lowpanOutDiscards OBJECT-TYPE

```
SYNTAX      Counter32  
MAX-ACCESS  read-only  
STATUS      current  
DESCRIPTION  
    "The number of IPv6 packets for which no problem was  
    encountered to prevent their transmission to their  
    destination, but were discarded (e.g., for lack of  
    buffer space)."
```

```
 ::= { lowpanStats 28 }
```

lowpanOutTransmits OBJECT-TYPE

```
SYNTAX      Counter32  
MAX-ACCESS  read-only  
STATUS      current  
DESCRIPTION  
    "The total number of 6LoWPAN datagram that this entity  
    supplied to the lower layers for transmission."  
 ::= { lowpanStats 29 }
```

lowpanIfStatsTable OBJECT-TYPE
 SYNTAX SEQUENCE OF LowpanIfStatsEntry
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION
 "A table providing per interface statistics."
 ::= { lowpanObjects 2 }

lowpanIfStatsEntry OBJECT-TYPE
 SYNTAX LowpanIfStatsEntry
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION
 "An entry providing statistics for a specific interface."
 INDEX { ifIndex }
 ::= { lowpanIfStatsTable 1 }

LowpanIfStatsEntry ::= SEQUENCE {
 lowpanIfReasmTimeout Unsigned32,
 lowpanIfInReceives Counter32,
 lowpanIfInHdrErrors Counter32,
 lowpanIfInMeshReceives Counter32,
 lowpanIfInMeshForwds Counter32,
 lowpanIfInMeshDelivers Counter32,
 lowpanIfInReasmReqds Counter32,
 lowpanIfInReasmFails Counter32,
 lowpanIfInReasmOKs Counter32,
 lowpanIfInCompReqds Counter32,
 lowpanIfInCompFails Counter32,
 lowpanIfInCompOKs Counter32,
 lowpanIfInDiscards Counter32,
 lowpanIfInDelivers Counter32,
 lowpanIfOutRequests Counter32,
 lowpanIfOutCompReqds Counter32,
 lowpanIfOutCompFails Counter32,
 lowpanIfOutCompOKs Counter32,
 lowpanIfOutFragReqds Counter32,

lowpanIfOutFragFails Counter32,
 lowpanIfOutFragOKs Counter32,
 lowpanIfOutFragCreates Counter32,
 lowpanIfOutMeshHopLimitExceeds Counter32,


```

lowpanIfOutMeshNoRoutes      Counter32,
lowpanIfOutMeshRequests     Counter32,
lowpanIfOutMeshForwds       Counter32,
lowpanIfOutMeshTransmits    Counter32,
lowpanIfOutDiscards         Counter32,
lowpanIfOutTransmits        Counter32
}

lowpanIfReasmTimeout OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "seconds"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The maximum number of seconds that received fragments are
    held while they are awaiting reassembly at this interface."
 ::= { lowpanIfStatsEntry 1 }

lowpanIfInReceives OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The total number of 6LoWPAN datagrams received on this
    interface, including those received in error."
 ::= { lowpanIfStatsEntry 2 }

lowpanIfInHdrErrors OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The number of 6LoWPAN datagrams received on this
    interface that were discarded due to errors in
    their headers, including unknown dispatch values."
 ::= { lowpanIfStatsEntry 3 }

lowpanIfInMeshReceives OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The number of 6LoWPAN datagrams received on this
    interface with a MESH header."

```

```
::= { lowpanIfStatsEntry 4 }
```

```
lowpanIfInMeshForwds OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The number of 6LoWPAN datagrams received on this  
interface requiring MESH forwarding."
```

```
::= { lowpanIfStatsEntry 5 }
```

```
lowpanIfInMeshDelivers OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The number of 6LoWPAN datagrams received on this  
interface with a MESH header delivered to the local  
system."
```

```
::= { lowpanIfStatsEntry 6 }
```

```
lowpanIfInReasmReqds OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The number of 6LoWPAN fragments received on this  
interface that needed to be reassembled. This  
includes both FRAG1 and FRAGN 6LoWPAN datagrams."
```

```
::= { lowpanIfStatsEntry 7 }
```

```
lowpanIfInReasmFails OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The number of failures detected by the re-assembly  
algorithm (e.g., timeouts) for datagrams received  
on this interface. Note that this is not necessarily  
a count of discarded 6LoWPAN fragments since  
implementations can lose track of the number  
of fragments by combining them as received."
```

```
::= { lowpanIfStatsEntry 8 }
```

```
lowpanIfInReasmOKs OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

STATUS current

Internet-Draft

LOWPAN-MIB

July 2014

DESCRIPTION

"The number of IPv6 packets successfully reassembled from fragments received on this interface."

::= { lowpanIfStatsEntry 9 }

lowpanIfInCompReqds OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of 6LoWPAN datagrams received on this interface requiring header decompression."

::= { lowpanIfStatsEntry 10 }

lowpanIfInCompFails OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of 6LoWPAN datagrams received on this interface where header decompression failed (e.g., because the necessary context information was not available)."

::= { lowpanIfStatsEntry 11 }

lowpanIfInCompOKs OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of 6LoWPAN datagrams received on this interface where header decompression was successful."

::= { lowpanIfStatsEntry 12 }

lowpanIfInDiscards OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of 6LoWPAN datagrams received on this

interface for which no problems were encountered to prevent their continued processing, but were discarded (e.g., for lack of buffer space). Note that this counter does not include any datagrams discarded due to a reassembly failure or a compression failure."
 ::= { lowpanIfStatsEntry 13 }

lowpanIfInDelivers OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"The total number of IPv6 packets received on this interface that were successfully delivered to the IPv6 layer."

::= { lowpanIfStatsEntry 14 }

lowpanIfOutRequests OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"The total number of IPv6 packets supplied by the IPv6 layer to be sent over this interface."

::= { lowpanIfStatsEntry 15 }

lowpanIfOutCompReqds OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"The total number of IPv6 packets to be sent over this interface for which header compression was attempted."

::= { lowpanIfStatsEntry 16 }

lowpanIfOutCompFails OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

```
    "The total number of IPv6 packets to be sent over
      this interface for which header compression failed."
 ::= { lowpanIfStatsEntry 17 }
```

lowpanIfOutCompOKs OBJECT-TYPE

```
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The total number of IPv6 packets to be sent over
      this interface for which header compression was
      successful."
 ::= { lowpanIfStatsEntry 18 }
```

lowpanIfOutFragReqds OBJECT-TYPE

```
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The number of IPv6 packets to be sent over this
      interface that required fragmentation in order
      to be transmitted."
 ::= { lowpanIfStatsEntry 19 }
```

lowpanIfOutFragFails OBJECT-TYPE

```
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The number of IPv6 packets to be sent over this
      interface that have been discarded because
      fragmentation failed."
 ::= { lowpanIfStatsEntry 20 }
```

lowpanIfOutFragOKs OBJECT-TYPE

```
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The number of IPv6 packets to be sent over this
      interface that have been successfully fragmented."
```

```
::= { lowpanIfStatsEntry 21 }
```

```
lowpanIfOutFragCreates OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The number of 6LoWPAN fragments that have been
generated on this interface as a result of
fragmentation. This includes both FRAG1 and FRAGN
6LoWPAN datagrams."
```

```
::= { lowpanIfStatsEntry 22 }
```

```
lowpanIfOutMeshHopLimitExceeds OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The number of 6LoWPAN datagrams to be sent on this
interface with a MESH header that were dropped
because the hop limit has been exceeded."
```

```
::= { lowpanIfStatsEntry 23 }
```

```
lowpanIfOutMeshNoRoutes OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The number of 6LoWPAN datagrams to be sent on this
interface with a MESH header that were dropped
because there was no forwarding information available."
```

```
::= { lowpanIfStatsEntry 24 }
```

```
lowpanIfOutMeshRequests OBJECT-TYPE
```

```
SYNTAX Counter32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The number of 6LoWPAN datagrams to be sent on this
interface requiring MESH header encapsulation."
```

```
::= { lowpanIfStatsEntry 25 }
```

lowpanIfOutMeshForwds OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of 6LoWPAN datagrams to be sent on this interface with a MESH header for which suitable forwarding information was available."

::= { lowpanIfStatsEntry 26 }

lowpanIfOutMeshTransmits OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of 6LoWPAN datagrams to be send on this interface with a MESH header created."

::= { lowpanIfStatsEntry 27 }

lowpanIfOutDiscards OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of IPv6 packets to be sent over this interface for which no problem was encountered to prevent their transmission to their destination, but were discarded (e.g., for lack of buffer space)."

::= { lowpanIfStatsEntry 28 }

lowpanIfOutTransmits OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The total number of 6LoWPAN datagrams to be sent on this interface that this entity supplied to the lower layers for transmission."

::= { lowpanIfStatsEntry 29 }

-- conformance definitions

```

lowpanGroups      OBJECT IDENTIFIER ::= { lowpanConformance 1 }
lowpanCompliances OBJECT IDENTIFIER ::= { lowpanConformance 2 }

lowpanCompliance MODULE-COMPLIANCE
  STATUS      current
  DESCRIPTION
    "Compliance statement for systems that implement 6LoWPAN."
  MODULE      -- this module
  MANDATORY-GROUPS {
    lowpanStatsGroup
  }
  GROUP       lowpanStatsMeshGroup
  DESCRIPTION
    "This group is mandatory for implementations that process
    or forward 6LoWPAN datagrams with mesh headers."
  GROUP       lowpanIfStatsGroup
  DESCRIPTION
    "This group is mandatory for implementations that expose
    per interface statistics."
  GROUP       lowpanIfStatsMeshGroup
  DESCRIPTION
    "This group is mandatory for implementations that expose
    per interface statistics and that process or forward
    6LoWPAN datagrams with mesh headers."
  ::= { lowpanCompliances 1 }

```

```

lowpanStatsGroup OBJECT-GROUP
  OBJECTS {
    lowpanReasmTimeout,
    lowpanInReceives,
    lowpanInHdrErrors,
    lowpanInMeshReceives,
    lowpanInReasmReqds,
    lowpanInReasmFails,
    lowpanInReasmOKs,
    lowpanInCompReqds,

```

```

    lowpanInCompFails,
    lowpanInCompOKs,
    lowpanInDiscards,
    lowpanInDelivers,
    lowpanOutRequests,

```



```

        lowpanOutCompReqds,
        lowpanOutCompFails,
        lowpanOutCompOKs,
        lowpanOutFragReqds,
        lowpanOutFragFails,
        lowpanOutFragOKs,
        lowpanOutFragCreates,
        lowpanOutDiscards,
        lowpanOutTransmits
    }
    STATUS          current
    DESCRIPTION
        "A collection of objects providing information and
        statistics about the processing of 6LoWPAN datagrams,
        excluding counters covering the processing of datagrams
        with a mesh headers."
    ::= { lowpanGroups 1 }

lowpanStatsMeshGroup OBJECT-GROUP
    OBJECTS {
        lowpanInMeshForwds,
        lowpanInMeshDelivers,
        lowpanOutMeshHopLimitExceeds,
        lowpanOutMeshNoRoutes,
        lowpanOutMeshRequests,
        lowpanOutMeshForwds,
        lowpanOutMeshTransmits
    }
    STATUS          current
    DESCRIPTION
        "A collection of objects providing information and
        statistics about the processing of 6LoWPAN datagrams
        with a 6LoWPAN mesh header."
    ::= { lowpanGroups 2 }

lowpanIfStatsGroup OBJECT-GROUP
    OBJECTS {
        lowpanIfReasmTimeout,
        lowpanIfInReceives,
        lowpanIfInHdrErrors,
        lowpanIfInMeshReceives,
        lowpanIfInReasmReqds,
        lowpanIfInReasmFails,

```

```

        lowpanIfInReasmOKs,
        lowpanIfInCompReqds,
        lowpanIfInCompFails,
        lowpanIfInCompOKs,
        lowpanIfInDiscards,
        lowpanIfInDelivers,
        lowpanIfOutRequests,
        lowpanIfOutCompReqds,
        lowpanIfOutCompFails,
        lowpanIfOutCompOKs,
        lowpanIfOutFragReqds,
        lowpanIfOutFragFails,
        lowpanIfOutFragOKs,
        lowpanIfOutFragCreates,
        lowpanIfOutDiscards,
        lowpanIfOutTransmits
    }
    STATUS          current
    DESCRIPTION
        "A collection of objects providing per interface
        information and statistics about the processing
        of 6LoWPAN datagrams, excluding counters covering
        the processing of datagrams with a mesh headers."
    ::= { lowpanGroups 3 }

```

lowpanIfStatsMeshGroup OBJECT-GROUP

```

    OBJECTS {
        lowpanIfInMeshForwds,
        lowpanIfInMeshDelivers,
        lowpanIfOutMeshHopLimitExceeds,
        lowpanIfOutMeshNoRoutes,
        lowpanIfOutMeshRequests,
        lowpanIfOutMeshForwds,
        lowpanIfOutMeshTransmits
    }
    STATUS          current
    DESCRIPTION
        "A collection of objects providing per interface
        information and statistics about the processing
        of 6LoWPAN datagrams with a 6LoWPAN mesh header."
    ::= { lowpanGroups 4 }

```

END

Internet-Draft

LOWPAN-MIB

July 2014

7. Security Considerations

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:

The read-only counters provide insights into the amount of 6LoWPAN traffic a node is receiving or transmitting. This might provide information whether a device is regularly exchanging information with other devices or whether a device is mostly not participating in any communication (e.g., the device might be "easier" to take away unnoticed). The reassembly counters could be used to direct denial of service attacks on the reassembly mechanism.

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 "XXXX" 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

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

9. Acknowledgements

This specification borrows heavily from the IP-MIB defined in [\[RFC4293\]](#).

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Schoenwaelder, et al. Expires January 26, 2015

[Page 25]

Internet-Draft

LOWPAN-MIB

July 2014

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Authors' Addresses

Juergen Schoenwaelder
Jacobs University
Campus Ring 1
Bremen 28759
Germany

E-Mail: j.schoenwaelder@jacobs-university.de

Anuj Sehgal
Jacobs University
Campus Ring 1
Bremen 28759
Germany

E-Mail: s.anuj@jacobs-university.de

Tina Tsou
Huawei Technologies (USA)
2330 Central Expressway
Santa Clara CA 95050
USA

E-Mail: tina.tsou.zouting@huawei.com

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

E-Mail: cathyzhou@huawei.com