          Dual-Stack Lite (DS-Lite) Management Information Base (MIB) for
                   Address Family Transition Routers (AFTRs)

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 managed objects for Address Family
   Transition Routers (AFTRs) of Dual-Stack Lite (DS-Lite).

Status of This Memo

   This is an Internet Standards Track document.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 7841.

   Information about the current status of this document, any errata,
   and how to provide feedback on it may be obtained at
   http://www.rfc-editor.org/info/rfc7870.

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1. Introduction

   Dual-Stack Lite [RFC6333] is a solution that offers both IPv4 and
   IPv6 connectivity to customers crossing an IPv6-only infrastructure.
   One of its key components is an IPv4-over-IPv6 tunnel, which is used
   to provide IPv4 connectivity across a service provider's IPv6
   network. Another key component is a carrier-grade IPv4-IPv4 Network
   Address Translation (NAT) to share service provider IPv4 addresses
   among customers.

   This document defines a portion of the Management Information Base
   (MIB) for use with network management protocols in the Internet
   community. This MIB module may be used for configuration and
   monitoring of Address Family Transition Routers (AFTRs) in a Dual-
   Stack Lite scenario.

2. Requirements Language

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and
   "OPTIONAL" in this document are to be interpreted as described in BCP
   14, RFC 2119 [RFC2119]. When these words are not in ALL CAPS (such
   as "should" or "Should"), they have their usual English meanings and
   are not to be interpreted as [RFC2119] key words.

3. 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
   [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].

4. Relationship to the IF-MIB

   The Interfaces MIB [RFC2863] defines generic managed objects for
   managing interfaces. Each logical interface (physical or virtual)
   has an ifEntry. Tunnels are handled by creating a logical interface
   (ifEntry) for each tunnel. Each DS-Lite tunnel endpoint also acts as
   a virtual interface that has a corresponding entry in the IP Tunnel
   MIB and Interface MIB. Those corresponding entries are indexed by
   ifIndex.

   The ifOperStatus in ifTable is used to represent whether the DS-Lite
   tunnel function has been triggered. The ifInUcastPkts defined in
   ifTable will represent the number of IPv4 packets that have been
   encapsulated into IPv6 packets sent to a Basic Bridging BroadBand
   (B4). The ifOutUcastPkts defined in ifTable contains the number of
   IPv6 packets that can be decapsulated to IPv4 in the virtual
   interface. Also, the IF-MIB defines ifMtu for the MTU of this tunnel
   interface, so the DS-Lite MIB does not need to define the MTU for the
   tunnel.

5. Difference from the IP Tunnel MIB and NATV2-MIB

   The key technologies for DS-Lite are IP-in-IP (IPv4-in-IPv6) tunnels
   and NAT (IPv4-to-IPv4 translation).

   Notes: According to Section 5.2 of [RFC6333], DS-Lite only defines
   IPv4 in IPv6 tunnels at this moment, but other types of encapsulation
   could be defined in the future. So, the DS-Lite MIB only supports
   IP-in-IP encapsulation. If another RFC defines other tunnel types in
   the future, the DS-Lite MIB will be updated then.

The NATV2-MIB [RFC7659] is designed to carry translation from any
address family to any address family; therefore, it supports IPv4-to-
IPv4 translation.

The IP Tunnel MIB [RFC4087] is designed to manage tunnels of any type
over IPv4 and IPv6 networks; therefore, it already supports IP-in-IP
tunnels. But in a DS-Lite scenario, the tunnel type is point-to-
multipoint IP-in-IP tunnels. The direct(2) defined in the IP Tunnel
MIB only supports point-to-point tunnels. So, it needs to define a
new tunnel type for DS-Lite.

However, the NATV2-MIB and IP Tunnel MIB together are not sufficient
to support DS-Lite. This document describes the specific features
for the DS-Lite MIB, as below.

In the DS-Lite scenario, the Address Family Transition Router (AFTR)
is not only the tunnel-end concentrator, but also an IPv4-to-IPv4
NAT. So, as defined in [RFC6333], when the IPv4 packets come back
from the Internet to the AFTR, it knows how to reconstruct the IPv6
encapsulation by doing a reverse lookup in the extended IPv4 NAT
binding table (Section 6.6 of [RFC6333]). The NAT binding table in
the AFTR is extended to include the IPv6 address of the tunnel
initiator. However, the NAT binding information defined in the
NATV2-MIB as natv2PortMapTable is indexed by the NAT instance,
protocol, and external realm and address. Because the
tunnelIfTable defined in the TUNNEL-MIB [RFC4087] is indexed by the
ifIndex, the DS-Lite MIB needs to define the tunnel objects to extend
the NAT binding entry by interface. Therefore, a combined MIB is
necessary.

An implementation of the IP Tunnel MIB is required for DS-Lite. As
the tunnel is not point-to-point in DS-Lite, it needs to define a new
tunnel type for DS-Lite. The tunnelIfEncapsMethod in the
tunnelIfEntry should be set to dsLite(17), and a corresponding entry
in the DS-Lite module will exist for every tunnelIfEntry with this
tunnelIfEncapsMethod. The tunnelIfRemoteInetAddress must be set to
"::".

6. Structure of the MIB Module

The DS-Lite MIB provides a way to monitor and manage the devices
(AFTRs) in a DS-Lite scenario through SNMP.

The DS-Lite MIB is configurable on a per-interface basis. It depends
on several parts of the IF-MIB [RFC2863], IP Tunnel MIB [RFC4087],
and NATV2-MIB [RFC7659].

6.1. The Object Group

   This group defines objects that are needed for the DS-Lite MIB.

6.1.1. The dsliteTunnel Subtree

   The dsliteTunnel subtree describes managed objects used for managing
   tunnels in the DS-Lite scenario. Because the
   tunnelInetConfigLocalAddress and the tunnelInetConfigRemoteAddress
   defined in the IP Tunnel MIB are not readable, a few new objects are
   defined in the DS-Lite MIB.

6.1.2. The dsliteNAT Subtree

   The dsliteNAT subtree describes managed objects used for
   configuration and monitoring of an AFTR that is capable of a NAT
   function. Because the NATV2-MIB supports the NAT management function
   in DS-Lite, we may reuse it in the DS-Lite MIB. The dsliteNAT
   subtree also provides the mapping information between the tunnel
   entry (dsliteTunnelEntry) and the NAT entry (dsliteNATBindEntry) by
   adding the IPv6 address of the B4 to the natv2PortMapEntry in the
   NATV2-MIB. The mapping behavior, filtering behavior, and pooling
   behavior described in this subtree are all defined in [RFC4787].

6.1.3. The dsliteInfo Subtree

   The dsliteInfo subtree provides statistical information for DS-Lite.

6.2. The Notification Group

   This group defines some notification objects for a DS-Lite scenario.

6.3. The Conformance Group

   The dsliteConformance subtree provides conformance information of MIB
   objects.

7. MIB Modules Required for IMPORTS

   This MIB module IMPORTs objects from [RFC2578], [RFC2580], [RFC2863],
   [RFC3411], [RFC4001], and [RFC7659].

8. Definitions

 DSLite-MIB DEFINITIONS ::= BEGIN

      IMPORTS
         MODULE-IDENTITY, OBJECT-TYPE, mib-2,
         NOTIFICATION-TYPE, Integer32,
         Counter64, Unsigned32
            FROM SNMPv2-SMI

         OBJECT-GROUP, MODULE-COMPLIANCE,
         NOTIFICATION-GROUP
            FROM SNMPv2-CONF

         SnmpAdminString
            FROM SNMP-FRAMEWORK-MIB

         ifIndex
            FROM IF-MIB

       InetAddress, InetAddressType, InetAddressPrefixLength,
       InetPortNumber
            FROM INET-ADDRESS-MIB

       ProtocolNumber, Natv2InstanceIndex, Natv2SubscriberIndex
            FROM NATV2-MIB;

      dsliteMIB MODULE-IDENTITY
      LAST-UPDATED "201605110000Z"   -- May 11, 2016
      ORGANIZATION "IETF Softwire Working Group"
      CONTACT-INFO
         "Yu Fu
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      DESCRIPTION
        "The MIB module is defined for management of objects in the
         DS-Lite scenario.

      REVISION   "201605110000Z"
      DESCRIPTION
        "Initial version. Published as RFC 7870."
        ::= { mib-2 240 }

   --Top-level components of this MIB module

      dsliteMIBObjects OBJECT IDENTIFIER
         ::= { dsliteMIB 1 }
      dsliteTunnel   OBJECT IDENTIFIER
         ::= { dsliteMIBObjects 1 }

      dsliteNAT   OBJECT IDENTIFIER
         ::= { dsliteMIBObjects 2 }

      dsliteInfo   OBJECT IDENTIFIER
         ::= { dsliteMIBObjects 3 }

   --Notifications section

```
    dsliteNotifications  OBJECT IDENTIFIER
       ::=  { dsliteMIB 0 }


--dsliteTunnel

--dsliteTunnelTable

    dsliteTunnelTable OBJECT-TYPE
       SYNTAX      SEQUENCE OF DsliteTunnelEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "The (conceptual) table containing information on
           configured tunnels.  This table can be used to map
           a B4 address to the associated AFTR address.  It can
           also be used for row creation."
       REFERENCE
          "B4, AFTR: RFC 6333."
       ::=  { dsliteTunnel 1 }

    dsliteTunnelEntry OBJECT-TYPE
       SYNTAX      DsliteTunnelEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "Each entry in this table contains the information on a
           particular configured tunnel."
           INDEX   { dsliteTunnelAddressType,
                     dsliteTunnelStartAddress,
                     dsliteTunnelEndAddress,
                     ifIndex }
       ::=  { dsliteTunnelTable 1 }

    DsliteTunnelEntry  ::=
       SEQUENCE {
         dsliteTunnelAddressType        InetAddressType,
         dsliteTunnelStartAddress       InetAddress,
         dsliteTunnelEndAddress         InetAddress,
         dsliteTunnelStartAddPreLen     InetAddressPrefixLength
       }

     dsliteTunnelAddressType OBJECT-TYPE
        SYNTAX     InetAddressType
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
           "This object MUST be set to the value of ipv6(2).
```

```
             It describes the address type of the IPv4-in-IPv6
             tunnel initiator and endpoint."
          REFERENCE
            "ipv6(2): RFC 4001."
          ::= { dsliteTunnelEntry 1 }

      dsliteTunnelStartAddress OBJECT-TYPE
          SYNTAX      InetAddress (SIZE (0..16))
          MAX-ACCESS not-accessible
          STATUS      current
          DESCRIPTION
             "The IPv6 address of the initiator of the tunnel.
             The address type is given by dsliteTunnelAddressType."
          ::= { dsliteTunnelEntry 2 }

      dsliteTunnelEndAddress OBJECT-TYPE
          SYNTAX      InetAddress (SIZE (0..16))
          MAX-ACCESS not-accessible
          STATUS      current
          DESCRIPTION
             "The IPv6 address of the endpoint of the tunnel.
             The address type is given by dsliteTunnelAddressType."
          ::= { dsliteTunnelEntry 3 }

      dsliteTunnelStartAddPreLen OBJECT-TYPE
          SYNTAX InetAddressPrefixLength
          MAX-ACCESS read-only
          STATUS current
          DESCRIPTION
             "The IPv6 prefix length of the IP address for the
              initiator of the tunnel(dsliteTunnelStartAddress)."
          ::= { dsliteTunnelEntry 4 }


    --dsliteNATBindTable(according to the NAPT scheme)

      dsliteNATBindTable OBJECT-TYPE
          SYNTAX      SEQUENCE OF DsliteNATBindEntry
          MAX-ACCESS not-accessible
          STATUS      current
          DESCRIPTION
             "This table contains information about currently
              active NAT binds in the NAT of the AFTR.  This table
              adds the IPv6 address of a B4 to the natv2PortMapTable
              defined in NATV2-MIB (RFC 7659)."
          REFERENCE
              "NATV2-MIB: Section 4 of RFC 7659."
          ::=  { dsliteNAT 1 }
```

```
      dsliteNATBindEntry OBJECT-TYPE
          SYNTAX     DsliteNATBindEntry
          MAX-ACCESS not-accessible
          STATUS     current
          DESCRIPTION
             "The entry in this table holds the mapping relationship
              between tunnel information and NAT bind information.
              Each entry in this table not only needs to match a
              corresponding entry in the natv2PortMapTable, but
              also a corresponding entry in the dsliteTunnelTable.
              So, the INDEX of the entry needs to match a corresponding
              value in the natv2PortMapTable INDEX and a corresponding
              value in the dsliteTunnelTable INDEX.  These entries are
              lost upon agent restart."
          REFERENCE
              "natv2PortMapTable: Section 4 of RFC 7659."
          INDEX   { dsliteNATBindMappingInstanceIndex,
                    dsliteNATBindMappingProto,
                    dsliteNATBindMappingExtRealm,
                    dsliteNATBindMappingExtAddressType,
                    dsliteNATBindMappingExtAddress,
                    dsliteNATBindMappingExtPort,
                    ifIndex,
                    dsliteTunnelStartAddress }
          ::= {  dsliteNATBindTable 1    }

      DsliteNATBindEntry  ::=
          SEQUENCE {
          dsliteNATBindMappingInstanceIndex  Natv2InstanceIndex,
          dsliteNATBindMappingProto          ProtocolNumber,
          dsliteNATBindMappingExtRealm       SnmpAdminString,
          dsliteNATBindMappingExtAddressType InetAddressType,
          dsliteNATBindMappingExtAddress     InetAddress,
          dsliteNATBindMappingExtPort        InetPortNumber,
          dsliteNATBindMappingIntRealm       SnmpAdminString,
          dsliteNATBindMappingIntAddressType InetAddressType,
          dsliteNATBindMappingIntAddress     InetAddress,
          dsliteNATBindMappingIntPort        InetPortNumber,
          dsliteNATBindMappingPool           Unsigned32,
          dsliteNATBindMappingMapBehavior    INTEGER,
          dsliteNATBindMappingFilterBehavior INTEGER,
          dsliteNATBindMappingAddressPooling INTEGER
          }

      dsliteNATBindMappingInstanceIndex OBJECT-TYPE
          SYNTAX Natv2InstanceIndex
          MAX-ACCESS not-accessible
          STATUS current
```

```
        DESCRIPTION
           "Index of the NAT instance that created this port
            map entry."
      ::= { dsliteNATBindEntry 1 }

    dsliteNATBindMappingProto OBJECT-TYPE
        SYNTAX       ProtocolNumber
        MAX-ACCESS   not-accessible
        STATUS       current
        DESCRIPTION
           "This object specifies the mapping's transport protocol
            number."
        ::= { dsliteNATBindEntry 2 }

    dsliteNATBindMappingExtRealm OBJECT-TYPE
        SYNTAX      SnmpAdminString (SIZE(0..32))
        MAX-ACCESS not-accessible
        STATUS      current
        DESCRIPTION
           "The realm to which dsliteNATBindMappingExtAddress
            belongs."
        ::= { dsliteNATBindEntry 3 }

    dsliteNATBindMappingExtAddressType OBJECT-TYPE
        SYNTAX InetAddressType
        MAX-ACCESS not-accessible
        STATUS current
        DESCRIPTION
          "Address type for the mapping's external address.
           This object MUST be set to the value of iPv4(1).
           The values of ipv6(2), ipv4z(3), and ipv6z(4) are
           not allowed."
        REFERENCE
          "ipv4(1), ipv6(2), iPv4z(3), and ipv6z(4): RFC 4001."
        ::= { dsliteNATBindEntry 4 }

    dsliteNATBindMappingExtAddress OBJECT-TYPE
        SYNTAX InetAddress (SIZE (0..4))
        MAX-ACCESS not-accessible
        STATUS current
        DESCRIPTION
          "The mapping's external address.  This is the source
           address for translated outgoing packets.  The address
           type is given by dsliteNATBindMappingExtAddressType."
        ::= { dsliteNATBindEntry 5 }

    dsliteNATBindMappingExtPort OBJECT-TYPE
        SYNTAX InetPortNumber
```

```
         MAX-ACCESS not-accessible
         STATUS current
         DESCRIPTION
           "The mapping's assigned external port number.
            This is the source port for translated outgoing
            packets.  This MUST be a non-zero value."
         ::= { dsliteNATBindEntry 6 }

      dsliteNATBindMappingIntRealm OBJECT-TYPE
         SYNTAX SnmpAdminString (SIZE(0..32))
         MAX-ACCESS read-only
         STATUS current
         DESCRIPTION
           "The realm to which natMappingIntAddress belongs.  This
            realm defines the IPv6 address space from which the
            tunnel source address is taken.  The realm of the
            encapsulated IPv4 address is restricted in scope to
            the tunnel, so there is no point in identifying it
            separately."
         ::= { dsliteNATBindEntry 7 }

   dsliteNATBindMappingIntAddressType OBJECT-TYPE
         SYNTAX InetAddressType
         MAX-ACCESS read-only
         STATUS current
         DESCRIPTION
            "Address type of the mapping's internal address.
             This object MUST be set to the value of iPv4z(3).
             The values of ipv4(1), ipv6(2), and ipv6z(4) are
             not allowed."
         REFERENCE
           "ipv4(1), ipv6(2), iPv4z(3), and ipv6z(4): RFC 4001."
         ::= { dsliteNATBindEntry 8 }

      dsliteNATBindMappingIntAddress OBJECT-TYPE
         SYNTAX InetAddress
         MAX-ACCESS read-only
         STATUS current
         DESCRIPTION
           "The mapping's internal address.  It is the IPv6 tunnel
            source address.  The address type is given by
            dsliteNATBindMappingIntAddressType."
         ::= { dsliteNATBindEntry 9 }

      dsliteNATBindMappingIntPort OBJECT-TYPE
         SYNTAX InetPortNumber
         MAX-ACCESS read-only
         STATUS current
```

```
        DESCRIPTION
         "The mapping's internal port number.  This MUST be a
          non-zero value."
         ::= { dsliteNATBindEntry 10 }

    dsliteNATBindMappingPool OBJECT-TYPE
        SYNTAX Unsigned32 (0|1..4294967295)
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          "Index of the pool that contains this mapping's external
           address and port.  If zero, no pool is associated with
           this mapping."
         ::= { dsliteNATBindEntry 11 }

    dsliteNATBindMappingMapBehavior OBJECT-TYPE
        SYNTAX INTEGER{
        endpointIndependent (0),
        addressDependent(1),
        addressAndPortDependent (2)
        }
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
          "Mapping behavior as described in Section 4.1 of RFC 4787.

           endpointIndependent(0), the behavior REQUIRED by
           RFC 4787, REQ-1 maps the source address and port to
           the same external address and port for all destination
           address and port combinations reached through the same
           external realm and using the given protocol.

           addressDependent(1) maps to the same external address
           and port for all destination ports at the same
           destination address reached through the same external
           realm and using the given protocol.

           addressAndPortDependent(2) maps to a separate external
           address and port combination for each different
           destination address and port combination reached
           through the same external realm.

           For the DS-Lite scenario, it must be
           addressAndPortDependent(2)."
        REFERENCE
          "Mapping behavior: Section 4.1 of RFC 4787.
           DS-Lite: RFC 6333."
         ::= { dsliteNATBindEntry 12 }
```

```
      dsliteNATBindMappingFilterBehavior OBJECT-TYPE
          SYNTAX INTEGER{
          endpointIndependent (0),
          addressDependent(1),
          addressAndPortDependent (2)
          }
          MAX-ACCESS read-only
          STATUS current
          DESCRIPTION
            "Filtering behavior as described in Section 5 of RFC 4787.

             endpointIndependent(0) accepts for translation packets
             from all combinations of remote address and port
             destined to the mapped external address and port via
             the given external realm and using the given protocol.

             addressDependent(1) accepts for translation packets from
             all remote ports from the same remote source address
             destined to the mapped external address and port via the
             given external realm and using the given protocol.

             addressAndPortDependent(2) accepts for translation only
             those packets with the same remote source address, port,
             and protocol incoming from the same external realm as
             identified when the applicable port map entry was
             created.

             RFC 4787, REQ-8 recommends either endpointIndependent(0)
             or addressDependent(1) filtering behavior, depending on
             whether application friendliness or security takes
             priority.

             For the DS-Lite scenario, it must be
             addressAndPortDependent(2)."
          REFERENCE
            "Filtering behavior: Section 5 of RFC 4787.
             DS-Lite: RFC 6333."
          ::= { dsliteNATBindEntry 13 }

      dsliteNATBindMappingAddressPooling OBJECT-TYPE
          SYNTAX INTEGER{
          arbitrary (0),
          paired (1)
          }
          MAX-ACCESS read-only
          STATUS current
```

          DESCRIPTION
            "Type of address pooling behavior that was used to create
             this mapping.

             arbitrary(0) pooling behavior means that the NAT instance
             may create the new port mapping using any address in the
             pool that has a free port for the protocol concerned.

             paired(1) pooling behavior, the behavior RECOMMENDED by RFC
             4787, REQ-2 means that once a given internal address has
             been mapped to a particular address in a particular pool,
             further mappings of the same internal address to that pool
             will reuse the previously assigned pool member address."
          REFERENCE
            "Pooling behavior: Section 4.1 of RFC 4787."
          ::= { dsliteNATBindEntry 14 }

     --dsliteInfo

     dsliteAFTRAlarmScalar OBJECT IDENTIFIER ::= { dsliteInfo 1 }

     dsliteAFTRAlarmB4AddrType OBJECT-TYPE
        SYNTAX   InetAddressType
        MAX-ACCESS accessible-for-notify
        STATUS current
        DESCRIPTION
           "This object indicates the address type of
            the B4, which will send an alarm."
        ::= { dsliteAFTRAlarmScalar 1 }

     dsliteAFTRAlarmB4Addr OBJECT-TYPE
        SYNTAX   InetAddress
        MAX-ACCESS accessible-for-notify
        STATUS current
        DESCRIPTION
           "This object indicates the IP address of
            B4, which will send an alarm. The address type is
            given by dsliteAFTRAlarmB4AddrType."
        ::= { dsliteAFTRAlarmScalar 2 }

     dsliteAFTRAlarmProtocolType OBJECT-TYPE
        SYNTAX INTEGER{
        tcp (0),
        udp (1),
        icmp (2),
        total (3)
        }

```
        MAX-ACCESS accessible-for-notify
        STATUS current
        DESCRIPTION
           "This object indicates the transport protocol type
            of alarm.

            tcp (0) means that the transport protocol type of
            alarm is tcp.

            udp (1) means that the transport protocol type of
            alarm is udp.

            icmp (2) means that the transport protocol type of
            alarm is icmp.

            total (3) means that the transport protocol type of
            alarm is total."
        ::= { dsliteAFTRAlarmScalar 3 }

    dsliteAFTRAlarmSpecificIPAddrType OBJECT-TYPE
        SYNTAX InetAddressType
        MAX-ACCESS accessible-for-notify
        STATUS current
        DESCRIPTION
           "This object indicates the address type of the IP address
            whose port usage has reached the threshold."
        ::= { dsliteAFTRAlarmScalar 4 }

     dsliteAFTRAlarmSpecificIP OBJECT-TYPE
        SYNTAX InetAddress
        MAX-ACCESS accessible-for-notify
        STATUS current
        DESCRIPTION
           "This object indicates the IP address whose port usage
            has reached the threshold.  The address type is given by
            dsliteAFTRAlarmSpecificIPAddrType."
        ::= { dsliteAFTRAlarmScalar 5 }

      dsliteAFTRAlarmConnectNumber OBJECT-TYPE
        SYNTAX Integer32 (60..90)
        MAX-ACCESS read-write
        STATUS current
        DESCRIPTION
           "This object indicates the notification threshold
            of the DS-Lite tunnels that is active in
            the AFTR device."
         REFERENCE
           "AFTR: Section 6 of RFC 6333."
```

```
      DEFVAL
         { 60 }
      ::= { dsliteAFTRAlarmScalar 6 }

   dsliteAFTRAlarmSessionNumber OBJECT-TYPE
      SYNTAX Integer32
      MAX-ACCESS read-write
      STATUS current
      DESCRIPTION
         "This object indicates the notification threshold of
          the IPv4 session for the user."
       REFERENCE
         "AFTR: Section 6 of RFC 6333
          B4: Section 5 of RFC 6333."
      DEFVAL
         { -1 }
      ::= { dsliteAFTRAlarmScalar 7 }

   dsliteAFTRAlarmPortNumber OBJECT-TYPE
      SYNTAX Integer32
      MAX-ACCESS read-write
      STATUS current
      DESCRIPTION
         "This object indicates the notification threshold of the NAT
          ports that have been used by the user."
      DEFVAL
         { -1 }
      ::= { dsliteAFTRAlarmScalar 8 }

   dsliteStatisticsTable OBJECT-TYPE
      SYNTAX SEQUENCE OF DsliteStatisticsEntry
      MAX-ACCESS not-accessible
      STATUS current
      DESCRIPTION
         "This table provides statistical information
          about DS-Lite."
      ::= { dsliteInfo 2 }

   dsliteStatisticsEntry OBJECT-TYPE
      SYNTAX DsliteStatisticsEntry
      MAX-ACCESS not-accessible
      STATUS current
      DESCRIPTION
         "Each entry in this table provides statistical information
          about DS-Lite."
      INDEX { dsliteStatisticsSubscriberIndex }
      ::= { dsliteStatisticsTable 1 }
```

```
   DsliteStatisticsEntry ::=
      SEQUENCE {
    dsliteStatisticsSubscriberIndex        Natv2SubscriberIndex,
    dsliteStatisticsDiscards               Counter64,
    dsliteStatisticsSends                  Counter64,
    dsliteStatisticsReceives               Counter64,
    dsliteStatisticsIpv4Session            Counter64,
    dsliteStatisticsIpv6Session            Counter64
   }

  dsliteStatisticsSubscriberIndex OBJECT-TYPE
    SYNTAX Natv2SubscriberIndex
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
       "Index of the subscriber or host.  A unique value,
        greater than zero, for each subscriber in the
        managed system."
     ::= { dsliteStatisticsEntry 1 }

  dsliteStatisticsDiscards OBJECT-TYPE
     SYNTAX Counter64
     MAX-ACCESS read-only
     STATUS current
     DESCRIPTION
        "This object indicates the number of packets
         discarded from this subscriber."
     ::= { dsliteStatisticsEntry 2 }

   dsliteStatisticsSends  OBJECT-TYPE
     SYNTAX Counter64
     MAX-ACCESS read-only
     STATUS current
     DESCRIPTION
        "This object indicates the number of packets that is
         sent to this subscriber."
     ::= { dsliteStatisticsEntry 3 }

  dsliteStatisticsReceives  OBJECT-TYPE
    SYNTAX Counter64
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
       "This object indicates the number of packets that is
        received from this subscriber."
     ::= { dsliteStatisticsEntry 4 }
```

```
     dsliteStatisticsIpv4Session OBJECT-TYPE
        SYNTAX Counter64
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
           "This object indicates the number of the
            current IPv4 Sessions."
        REFERENCE
            "Session: Paragraph 2 in Section 11 of RFC 6333.
             (The AFTR should have the capability to log the
              tunnel-id, protocol, ports/IP addresses, and
              the creation time of the NAT binding to uniquely
              identify the user sessions)."
        ::= { dsliteStatisticsEntry 5 }

     dsliteStatisticsIpv6Session OBJECT-TYPE
        SYNTAX Counter64
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
           "This object indicates the number of the
            current IPv6 session.  Because the AFTR is
            also a dual-stack device, it will also
            forward normal IPv6 packets for the
            inbound and outbound direction."
        REFERENCE
            "Session: Paragraph 2 in Section 11 of RFC 6333.
             (The AFTR should have the capability to log the
              tunnel-id, protocol, ports/IP addresses, and
              the creation time of the NAT binding to uniquely
              identify the user sessions)."
         ::= { dsliteStatisticsEntry 6 }

   ---dslite Notifications

     dsliteTunnelNumAlarm NOTIFICATION-TYPE
        OBJECTS { dsliteAFTRAlarmProtocolType,
                  dsliteAFTRAlarmB4AddrType,
                  dsliteAFTRAlarmB4Addr }
        STATUS current
        DESCRIPTION
           "This trap is triggered when the number of
            current DS-Lite tunnels exceeds the value of
            the dsliteAFTRAlarmConnectNumber."
        ::= { dsliteNotifications 1 }
```

```
      dsliteAFTRUserSessionNumAlarm NOTIFICATION-TYPE
         OBJECTS { dsliteAFTRAlarmProtocolType,
               dsliteAFTRAlarmB4AddrType,
               dsliteAFTRAlarmB4Addr }
         STATUS current
         DESCRIPTION
            "This trap is triggered when user sessions
             reach the threshold.  The threshold
             is specified by the dsliteAFTRAlarmSessionNumber."
         REFERENCE
             "Session: Paragraph 2 in Section 11 of RFC 6333.
             (The AFTR should have the capability to log the
              tunnel-id, protocol, ports/IP addresses, and
              the creation time of the NAT binding to uniquely
              identify the user sessions)."
         ::= { dsliteNotifications 2 }

       dsliteAFTRPortUsageOfSpecificIpAlarm NOTIFICATION-TYPE
         OBJECTS { dsliteAFTRAlarmSpecificIPAddrType,
                   dsliteAFTRAlarmSpecificIP }
         STATUS current
         DESCRIPTION
            "This trap is triggered when the used NAT
             ports of map address reach the threshold.
             The threshold is specified by the
             dsliteAFTRAlarmPortNumber."
         ::= { dsliteNotifications 3 }

   --Module Conformance statement

      dsliteConformance   OBJECT IDENTIFIER
         ::=  { dsliteMIB 2 }

      dsliteCompliances OBJECT IDENTIFIER ::= { dsliteConformance 1 }

      dsliteGroups OBJECT IDENTIFIER ::= { dsliteConformance 2 }

   -- compliance statements

      dsliteCompliance MODULE-COMPLIANCE
          STATUS current
          DESCRIPTION
             "Describes the minimal requirements for conformance
              to the DS-Lite MIB."
          MODULE -- this module
             MANDATORY-GROUPS { dsliteNATBindGroup,
                 dsliteTunnelGroup,
                 dsliteStatisticsGroup,
```

```
                  dsliteNotificationsGroup,
                  dsliteAFTRAlarmScalarGroup }
            ::= { dsliteCompliances 1 }

      dsliteNATBindGroup OBJECT-GROUP
         OBJECTS {
                  dsliteNATBindMappingIntRealm,
                  dsliteNATBindMappingIntAddressType,
                  dsliteNATBindMappingIntAddress,
                  dsliteNATBindMappingIntPort,
                  dsliteNATBindMappingPool,
                  dsliteNATBindMappingMapBehavior,
                  dsliteNATBindMappingFilterBehavior,
                  dsliteNATBindMappingAddressPooling }
         STATUS current
         DESCRIPTION
            "A collection of objects to support basic
             management of NAT binds in the NAT of the AFTR."
          ::= { dsliteGroups 1 }

      dsliteTunnelGroup OBJECT-GROUP
         OBJECTS { dsliteTunnelStartAddPreLen }
         STATUS current
         DESCRIPTION
            "A collection of objects to support management
             of DS-Lite tunnels."
          ::= { dsliteGroups 2 }

      dsliteStatisticsGroup OBJECT-GROUP
         OBJECTS { dsliteStatisticsDiscards,
                   dsliteStatisticsSends,
                   dsliteStatisticsReceives,
                   dsliteStatisticsIpv4Session,
                   dsliteStatisticsIpv6Session }
        STATUS current
        DESCRIPTION
          " A collection of objects to support management
            of statistical information for AFTR devices."
           ::= { dsliteGroups 3 }

      dsliteNotificationsGroup NOTIFICATION-GROUP
         NOTIFICATIONS { dsliteTunnelNumAlarm,
                         dsliteAFTRUserSessionNumAlarm,
                         dsliteAFTRPortUsageOfSpecificIpAlarm }
         STATUS current
         DESCRIPTION
            "A collection of objects to support management
             of trap information for AFTR devices."
```

```
      ::= { dsliteGroups 4 }

   dsliteAFTRAlarmScalarGroup OBJECT-GROUP
     OBJECTS { dsliteAFTRAlarmB4AddrType,
          dsliteAFTRAlarmB4Addr,
          dsliteAFTRAlarmProtocolType,
          dsliteAFTRAlarmSpecificIPAddrType,
          dsliteAFTRAlarmSpecificIP,
          dsliteAFTRAlarmConnectNumber,
          dsliteAFTRAlarmSessionNumber,
          dsliteAFTRAlarmPortNumber}
     STATUS current
     DESCRIPTION
          "A collection of objects to support management of
          the information about the AFTR alarming scalar."
     ::= { dsliteGroups 5 }

          END
```

9. 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 opens devices to attack. These
   are the tables and objects and their sensitivity/vulnerability:

      dsliteAFTRAlarmConnectNumber

      dsliteAFTRAlarmSessionNumber

      dsliteAFTRAlarmPortNumber

   Notification thresholds: An attacker setting an arbitrarily low
   threshold can cause many useless notifications to be generated.
   Setting an arbitrarily high threshold can effectively disable
   notifications, which could be used to hide another attack.

   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:

entries in dsliteTunnelTable

entries in dsliteNATBindTable

Objects that reveal host identities: Various objects can reveal the
identity of private hosts that are engaged in a session with external
end nodes. A curious outsider could monitor these to assess the
number of private hosts being supported by the AFTR device. Further,
a disgruntled former employee of an enterprise could use the
information to break into specific private hosts by intercepting the
existing sessions or originating new sessions into the host. If
nothing else, unauthorized monitoring of these objects will violate
individual subscribers' privacy.

Unauthorized read access to the dsliteTunnelTable would reveal
information about the tunnel topology.

SNMP versions prior to SNMPv3 did not include adequate security.
Even if the network itself is secure (for example by using IPsec),
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.

Implementations SHOULD provide the security features described by the
SNMPv3 framework (see [RFC3410]), and implementations claiming
compliance to the SNMPv3 standard MUST include full support for
authentication and privacy via the User-based Security Model (USM)
[RFC3414] with the AES cipher algorithm [RFC3826]. Implementations
MAY also provide support for the Transport Security Model (TSM)
[RFC5591] in combination with a secure transport such as SSH
[RFC5592] or TLS/DTLS [RFC6353].

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.

10. IANA Considerations

   IANA has allocated the following OBJECT IDENTIFIER value and recorded
   it in the SMI Numbers registry in the subregistry called "SMI Network
   Management MGMT Codes Internet-standard MIB" under the mib-2 branch
   (1.3.6.1.2.1):

         Descriptor   OBJECT IDENTIFIER value
         ----------   -----------------------
         DSLite-MIB   { mib-2 240 }

   IANA has recorded the following IANAtunnelType Textual Convention
   within the IANAifType-MIB:

         IANAtunnelType ::= TEXTUAL-CONVENTION
                    SYNTAX   INTEGER {
                            dsLite(17)   -- DS-Lite tunnel
                            }

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