Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: February 4, 2017

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August 3, 2016

# A YANG Data Model for the DS-Lite Address Family Transition Router (AFTR)
## draft-ietf-softwire-dslite-yang-00

Abstract

This document defines a YANG data model for the DS-Lite Address Family Transition Router (AFTR).

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## 1. Introduction

This document defines a data model for DS-Lite [RFC6333], using the YANG data modeling language [RFC6020]. Only the Address Family Transition Router (AFTR) element is covered by this specification. As a reminder, [RFC6334] can be used to configure the name of the AFTR to a Basic Bridging BroadBand (B4) element.

DS-Lite deployment considerations are discussed in [RFC6908].

This document follows the guidelines of [RFC6087].

This document uses the common YANG types defined in [RFC6991].

### 1.1. Terminology

This document makes use of the terms defined in [RFC6333].

The terminology for describing YANG data models is defined in [RFC6020].

### 1.2. Tree Diagrams

The meaning of the symbols in these diagrams is as follows:

- Brackets "[" and "]" enclose list keys.
- Curly braces "{" and "}" contain names of optional features that make the corresponding node conditional.
- Abbreviations before data node names: "rw" means configuration (read-write), "ro" state data (read-only).

- Symbols after data node names: "?" means an optional node, "!" a container with presence, and "*" denotes a "list" or "leaf-list".

- Parentheses enclose choice and case nodes, and case nodes are also marked with a colon (":").

- Ellipsis ("...") stands for contents of subtrees that are not shown.

## 2. DS-Lite AFTR YANG Data Model

Figure 1 depicts the YANG data model for the AFTR element.

A device can enable multiple AFTR instances; each responsible to service a group of B4s. The data model assumes that each AFTR instance can: be enable/disabled, be provisioned with a dedicated configuration data, and maintain its own mapping table. The data model assumes that pools of IPv4 addresses can be provisioned to the AFTR. These pools may be contiguous or non-contiguous. Also, it assumes that an AFTR can either assign individual port numbers or port sets.

This document assumes [RFC4787][RFC5382][RFC5508] are enabled by default. Also, the data model relies on the recommendations in [RFC6888] and [RFC7857]. In addition, the data model supports state migration as per [RFC7785].

PCP-related considerations are out of scope of the document. A YANG data model for PCP is documented in [I-D.boucadair-pcp-yang].

```
module: ietf-dslite-aftr
 +--rw dslite-aftr-config
 |  +--rw enable?                  boolean
 |  +--rw dslite-aftr-instances
 |     +--rw dslite-aftr-instance* [id]
 |        +--rw id                                  uint32
 |        +--rw name?                               string
 |        +--rw dslite-aftr-ip-address* [address-id]
 |        |  +--rw address-id       uint32
 |        |  +--rw ip-address?     inet:ipv6-address
 |        +--rw ipv4-address?           inet:ipv4-address
 |        +--rw tunnel-mtu?                         uint16
 |        +--rw external-ip-address-pool*    [address-id]
 |        |  +--rw address-id          uint32
 |        |  +--rw external-ip-pool?   inet:ipv4-prefix
 |        +--rw subscriber-mask?                    uint8
 |        +--rw nat-mapping-type?                   enumeration
 |        +--rw nat-filtering-type?                 enumeration
```

```
|       +--rw port-quota                          uint16
|       +--rw exclude-ports* [id]
|       |  +--rw id                    uint16
|       |  +--rw (port-type)?
|       |     +--:(single-port-number)
|       |     |  +--rw single-port-number?   inet:port-number
|       |     +--:(port-range)
|       |        +--rw start-port-number?    inet:port-number
|       |        +--rw end-port-number?      inet:port-number
|       +--rw port-set
|       |  +--rw port-set-enable?    boolean
|       |  +--rw port-set-size?      uint16
|       |  +--rw port-set-timeout?   uint32
|       +--rw enable-app?                           boolean
|       +--rw max-softwire-per-subscriber?          uint8
|       +--rw transport-protocol* [transport-protocol-id]
|       |  +--rw transport-protocol-id     uint8
|       +--rw new-mappings-rate-limit?              uint32
|       +--rw mss-clamping-enable?                  boolean
|       +--rw port-randomization-enable?            boolean
|       +--rw port-preservation-enable?             boolean
|       +--rw port-parity-preservation-enable?      boolean
|       +--rw udp-lifetime?                         uint32
|       +--rw tcp-idle-timeout?                     uint32
|       +--rw tcp-trans-open-timeout?               uint32
|       +--rw tcp-trans-close-timeout?              uint32
|       +--rw tcp-in-syn-timeout?                   uint32
|       +--rw fragment-min-timeout?                 uint32
|       +--rw icmp-timeout?                         uint32
|       +--rw hold-down-timeout?                    uint32
|       +--rw v6-v4-dscp-preservation               boolean
|       +--rw logging-info
|       |  +--rw logging-enable?        boolean
|       |  +--rw destination-address?   inet:ip-prefix
|       |  +--rw destination-port?      inet:port-number
|       +--rw notify-address-pool-usage
|       |  +--rw pool-id?                      uint32
|       |  +--rw notify-pool-hi-threshold      percent
|       |  +--rw notify-pool-low-threshold?    percent
|       +--rw ftp-alg-enable?                       boolean
|       +--rw tftp-alg-enable?                      boolean
|       +--rw sip-alg-enable?                       boolean
|       +--rw rtsp-alg-enable?                      boolean
|       +--rw h323-alg-enable?                      boolean
|       +--rw all-algs-enable?                      boolean
|       +--rw mapping-table
|          +--rw mapping-entry* [index]
|             +--rw index                    uint32
```

```
 |              +--rw status?                enumeration
 |              +--rw type?                  enumeration
 |              +--rw b4-ip-address          inet:ipv6-address
 |              +--rw internal-ip-address     inet:ipv4-prefix
 |              +--rw internal-port
 |              |  +--rw (port-type)?
 |              |     +--:(single-port-number)
 |              |     |  +--rw single-port-number?   inet:port-number
 |              |     +--:(port-range)
 |              |        +--rw start-port-number?    inet:port-number
 |              |        +--rw end-port-number?      inet:port-number
 |              +--rw external-ip-address      inet:ipv4-address
 |              +--rw external-port
 |              |  +--rw (port-type)?
 |              |     +--:(single-port-number)
 |              |     |  +--rw single-port-number?   inet:port-number
 |              |     +--:(port-range)
 |              |        +--rw start-port-number?    inet:port-number
 |              |        +--rw end-port-number?      inet:port-number
 |              +--rw transport-protocol     uint8
 |              +--rw lifetime               uint32
 |              +--rw v6-dscp?               uint8
 |              +--rw internal-v4-dscp?      uint8
 |              +--rw external-v4-dscp?      uint8
 |              +--rw description?           string
 +--ro dslite-aftr-state
    +--ro dslite-aftr-instances
       +--ro dslite-aftr-instance* [id]
          +--ro id                    int32
          +--ro name?                 string
          +--ro aftr-capabilities
          |  +--ro eim-support?                          boolean
          |  +--ro eif-support?                          boolean
          |  +--ro edm-support?                          boolean
          |  +--ro edf-support?                          boolean
          |  +--ro adm-support?                          boolean
          |  +--ro adf-support?                          boolean
          |  +--ro pcp-support?                          boolean
          |  +--ro subscriber-mask-support?              boolean
          |  +--ro port-set-support?                     boolean
          |  +--ro self-state-migration-support?         boolean
          |  +--ro mss-clamping-support?                 boolean
          |  +--ro port-randomization-support?           boolean
          |  +--ro port-preservation-suport?             boolean
          |  +--ro port-parity-preservation-support?     boolean
          |  +--ro transport-proto-capabilities* [transport-protocol-id]
          |  |  +--ro transport-protocol-id         uint8
          |  +--ro v6-v4-dscp-preservation-support?    boolean
```

```
|  +--ro logging-support?                    boolean
|  +--ro ftp-alg-support?                    boolean
|  +--ro tftp-support?                       boolean
|  +--ro sip-alg-support?                    boolean
|  +--ro rtsp-alg-support?                   boolean
|  +--ro h323-alg-support?                   boolean
+--ro aftr-current-config
|  +--ro dslite-aftr-ip-address* [address-id]
|  |  +--ro address-id          uint32
|  |  +--ro ip-address?          inet:ipv6-address
|  +--ro ipv4-address?                       inet:ipv4-address
|  +--ro tunnel-mtu?                         uint16
|  +--ro external-ip-address-pool* [address-id]
|  |  +--ro address-id          uint32
|  |  +--ro external-ip-pool?   inet:ipv4-prefix
|  +--ro subscriber-mask?                    uint8
|  +--ro port-quota                          uint16
|  +--ro exclude-ports* [id]
|  |  +--ro id                    uint16
|  |  +--ro (port-type)?
|  |     +--:(single-port-number)
|  |     |  +--ro single-port-number?   inet:port-number
|  |     +--:(port-range)
|  |        +--ro start-port-number?    inet:port-number
|  |        +--ro end-port-number?      inet:port-number
|  +--ro port-set
|  |  +--ro port-set-enable?    boolean
|  |  +--ro port-set-size?      uint16
|  |  +--ro port-set-timeout?   uint32
|  +--ro enable-app?                         boolean
|  +--ro max-softwire-per-subscriber?        uint8
|  +--ro transport-protocol* [transport-protocol-id]
|  |  +--ro transport-protocol-id      uint8
|  +--ro new-mappings-rate-limit?            uint32
|  +--ro mss-clamping-enable?                boolean
|  +--ro port-randomization-enable?          boolean
|  +--ro port-preservation-enable?           boolean
|  +--ro port-parity-preservation-enable?    boolean
|  +--ro udp-lifetime?                       uint32
|  +--ro tcp-idle-timeout?                   uint32
|  +--ro tcp-trans-open-timeout?             uint32
|  +--ro tcp-trans-close-timeout?            uint32
|  +--ro tcp-in-syn-timeout?                 uint32
|  +--ro fragment-min-timeout?               uint32
|  +--ro icmp-timeout?                       uint32
|  +--ro hold-down-timeout?                  uint32
|  +--ro v6-v4-dscp-preservation             boolean
|  +--ro logging-info
```

```
|  |  +--ro logging-enable?        boolean
|  |  +--ro destination-address?   inet:ip-prefix
|  |  +--ro destination-port?      inet:port-number
|  +--ro notify-address-pool-usage
|     +--ro pool-id?                      uint32
|     +--ro notify-pool-hi-threshold      percent
|     +--ro notify-pool-low-threshold?    percent
+--ro mapping-table
|  +--ro mapping-entry* [index]
|     +--ro index                    uint32
|     +--ro status?                  enumeration
|     +--ro type?                    enumeration
|     +--ro b4-ip-address            inet:ipv6-address
|     +--ro internal-ip-address      inet:ipv4-prefix
|     +--ro internal-port
|     |  +--ro (port-type)?
|     |     +--:(single-port-number)
|     |     |  +--ro single-port-number?   inet:port-number
|     |     +--:(port-range)
|     |        +--ro start-port-number?    inet:port-number
|     |        +--ro end-port-number?      inet:port-number
|     +--ro external-ip-address      inet:ipv4-address
|     +--ro external-port
|     |  +--ro (port-type)?
|     |     +--:(single-port-number)
|     |     |  +--ro single-port-number?   inet:port-number
|     |     +--:(port-range)
|     |        +--ro start-port-number?    inet:port-number
|     |        +--ro end-port-number?      inet:port-number
|     +--ro transport-protocol     uint8
|     +--ro lifetime               uint32
|     +--ro v6-dscp?               uint8
|     +--ro internal-v4-dscp?      uint8
|     +--ro external-v4-dscp?      uint8
|     +--ro description?           string
+--ro statistics
|  +--ro traffic-statistics
|  |  +--ro sent-packet?      yang:zero-based-counter64
|  |  +--ro sent-byte?        yang:zero-based-counter64
|  |  +--ro rcvd-packet?      yang:zero-based-counter64
|  |  +--ro rcvd-byte?        yang:zero-based-counter64
|  |  +--ro dropped-packet?   yang:zero-based-counter64
|  |  +--ro dropped-byte?     yang:zero-based-counter64
|  +--ro mapping-table-stats
|     +--ro current-mt-size?   yang:zero-based-counter64
|     +--ro max-mt-size?       uint32
|     +--ro total-tcp-mappings?    uint32
|     +--ro total-udp-mappings?    uint32
```

```
          |     +--ro total-icmp-mappings?   uint32
          +--ro available-capacity-client?   percent
          +--ro available-capacity-ext?      percent
          +--ro address-pool-in-use?         percent
          +--ro port-in-use?                 percent
```

Figure 1: YANG Data Model for DS-Lite AFTR

The following notifications are supported. These notifications are triggered by configurable parameters.

```
notifications:
  +---n dslite-aftr-event
     +--ro id?              -> /dslite-aftr-state/dslite-aftr-instances/
     |                      dslite-aftr-instance/id
     +--ro notify-pool-threshold  percent
```

## 3. AFTR YANG Module

```
  <CODE BEGINS> file "ietf-dslite-aftr@2016-07-27.yang"
  module ietf-dslite-aftr {
      namespace "urn:ietf:params:xml:ns:yang:ietf-dslite-aftr";
      prefix dslite-aftr;

      import ietf-inet-types { prefix inet; }
      import ietf-yang-types { prefix yang; }

      organization "Softwire Working Group";
      contact
       "Mohamed Boucadair <mohamed.boucadair@orange.com>
        Christian Jacquenet <christian.jacquenet@orange.com>
        Senthil Sivakumar (ssenthil) <ssenthil@cisco.com>";

     description
        "This module is a YANG module for DS-Lite AFTR
        implementations.

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        authors of the code.  All rights reserved.

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        Relating to IETF Documents
        (http://trustee.ietf.org/license-info).
```

```
       This version of this YANG module is part of RFC XXXX; see
       the RFC itself for full legal notices.";

    revision 2016-07-27 {
      description "-00 IETF version.";
       reference "-ietf-00";
    }

    revision 2016-06-13 {
      description "Update the module.";
       reference "-04";
    }

    revision 2015-12-16 {
      description "Fix an error.";
       reference "-03";
    }

    revision 2015-09-01 {
      description "Add port treshhold notifications.";
       reference "-02";
    }

    revision 2015-08-31 {
      description "Fix a timeout issue.";
       reference "-01";
    }

    revision 2015-08-17 {
      description "First spec.";
       reference "-00";
    }

  // Typedef

  typedef percent {
      type uint8 {
              range "0 .. 100";
      }
      description
          "Percentage";
  }

  /*
   * Grouping
   */

  // port numbers: single or port range
```

```
  grouping port-number {
      description
          "Individual port or a range of ports.";

      choice port-type {
          default single-port-number;
          description
              "Port type: single or port-range.";

          case single-port-number {
              leaf single-port-number {
                  type inet:port-number;
                  description
                      "Used for single port numbers.";
              }
          }

          case port-range {
              leaf start-port-number {
                  type inet:port-number;
                  description
                      "Begining of the port range.";
              }

              leaf end-port-number {
                  type inet:port-number;
                  description
                      "End of the port range.";
              }
          }
      }
  }

  // Timeout variables

  grouping lifetime {
     description
      "Configure values of various timeouts.";

      leaf udp-lifetime {
          type uint32;
          default 120;
          description
              "UDP inactivity timeout [RFC4787].";
      }

      leaf tcp-idle-timeout {
          type uint32;
```

```
          default 7440;
          description
              "TCP Idle timeout as per RFC 5382 should be no
               more than 2 hours and 4 minutes.";
      }

      leaf tcp-trans-open-timeout {
          type uint32;
          default 240;
          description
            "The value of the transitory open connection
            idle-timeout.
            Section 2.1 of [RFC7857] clarifies that a NAT
            should provide different configurable
            parameters for configuring the open and
            closing idle timeouts.
            To accommodate deployments that consider
            a partially open timeout of 4 minutes as being
            excessive from a security standpoint, a NAT may
            allow the configured timeout to be less than
            4 minutes.
            However, a minimum default transitory connection
            idle-timeout of 4 minutes is recommended.";
      }

      leaf tcp-trans-close-timeout {
          type uint32;
          default 240;
          description
            "The value of the transitory close connection
            idle-timeout.
            Section 2.1 of [RFC7857] clarifies that a NAT
            should provide different configurable
            parameters for configuring the open and
            closing idle timeouts.";
      }

      leaf tcp-in-syn-timeout {
          type uint32;
          default 6;
          description
            "6 seconds, as defined in [RFC5382].";
      }

      leaf fragment-min-timeout {
          type uint32;
          default 2;
          description
```

```
            "As long as the AFTR has available resources,
            the AFTR allows the fragments to arrive
            over fragment-min-timeout interval.
            The default value is inspired from RFC6146.";
        }

        leaf icmp-timeout {
            type uint32;
            default 60;
            description
                "60 seconds, as defined in [RFC5508].";
        }

        leaf hold-down-timeout {
            type uint32;
            default 120;
            description
                "Hold down timer. Ports in the
                hold down pool are not reassigned till
                this timer expires.
                The length of time and the maximum
                number of ports in this state must be
                configurable by the administrator
                [RFC6888]. This is necessary in order
                to prevent collisions between old
                and new mappings and sessions. It ensures
                that all established sessions are broken
                instead of redirected to a different peer.
                The default value is defined in REQ#8
                from [RFC6888].";
        }
    }
    // AFTR Parameters

    grouping aftr-parameters {

        description
           "A set of AFTR parameters";

        list dslite-aftr-ipv6-address {

            key address-id;

            description
              "set one or multiple IP addresses for
               the dslite-aftr";

            leaf address-id {
```

```
            type uint32;
            description
               "The identifier of the address";
          }

           leaf ipv6-address {
            type inet:ipv6-address;
            description
              "IPv6 address of the dslite-aftr.";
          }
        }
        leaf ipv4-address {
          type inet:ipv4-address;
          description
            "IPv4 address of the DS-Lite AFTR.
            192.0.0.1 is reserved for the AFTR element
            [RFC6333].
            This address can be used to report ICMP
            problems and will appear in traceroute
            outputs.";
        }

        leaf tunnel-mtu {
          type uint16;
          description
              "Configures a tunnel MTU.
              [RFC6908] specifies that since
              fragmentation and reassembly is not
              optimal, the operator should do
              everything possible to eliminate
              the need for it.  If the operator uses
              simple IPv4-in-IPv6 softwire, it is
              recommended that the MTU size of the IPv6
              network between the B4 and the AFTR
              accounts for the additional overhead
              (40 bytes).";
        }

        list external-ip-address-pool {

          key address-id;

          description
           "Pool of external IP addresses used to service
            internal hosts.
            Both contiguous and non-contiguous pools
            can be configured to an AFTR.
            Refer to REQ-3 of [RFC6888].";
```

```
          leaf address-id {
              type uint32;
              description
                "An identifier of the address.";
          }

          leaf external-ip-pool {
              type inet:ipv4-prefix;
              description
                "An IPv4 prefix used by the AFTR
                 for NAT purposes.";
          }
      }

      leaf subscriber-mask {
          type uint8 {
              range "0 .. 128";
              }
          default "56";
          description
              "The subscriber-mask is an integer that indicates
               the length of significant bits to be applied on
               the source IPv6 address (internal side) to
               unambiguously identify a CPE.

               Subscriber-mask is a system-wide configuration
               parameter that is used to enforce generic
               per-subscriberpolicies (e.g., port-quota).

               The enforcement of these generic policies does not
               require the configuration of every subscriber's prefix.

               Example: suppose the 2001:db8:100:100::/56 prefix is
               assigned to a DS-Lite enabled CPE. Suppose also that the
               2001:db8:100:100::1 is the IPv6 address used by the
               B4 that resides in that CPE. When the AFTR
               receives a packet from this client,
               it applies the subscriber-mask (e.g., 56) on
               the source IPv6 address to compute the associated prefix
               for this client (that is 2001:db8:100:100::/56).  Then,
               the AFTR enforces policies based on that prefix
               (2001:db8:100:100::/56), not on the exact
               source IPv6 address [RFC7785].";
      }

     leaf nat-mapping-type {
            type enumeration {
                    enum "eim"  {
```

```
                        description
                            "Endpoint-Independent-Mapping.
                            Refer to Section 4 of [RFC4787].";
                          }

                     enum "adm"  {
                         description
                            "Address-Dependent-Mapping.
                             Refer to Section 4 of [RFC4787].";
                           }

                       enum "edm"  {
                           description
                             "address-and-port-Dependent-Mapping.
                              Refer to Section 4 of [RFC4787].";
                           }
                        }
                  description
                     "Indicates the type of the NAT mapping.";
      }

      leaf nat-filtering-type {
               type enumeration {
                     enum "eif"  {
                        description
                           "Endpoint-Independent-Filtering.
                           Refer to Section 5 of [RFC4787].";
                         }

                     enum "adf"  {
                          description
                             "Address-Dependent-Filtering.
                             Refer to Section 5 of [RFC4787].";
                     }

                     enum "edf"  {
                       description
                           "address-and-port-Dependent-Filtering.
                            Refer to Section 5 of [RFC4787].";
                           }
                      }
            description
              "Indicates the type of the NAT filtering.";
      }

      leaf port-quota {
          type uint16;
          mandatory true;
```

```
          description
            "Configures a port quota to be assigned per
            subscriber.
            According to [RFC6888], per-subscriber limits
            must be configurable by the administrator.";
      }

      list exclude-ports {
          key "id";
          description
             "The set of ports not to be assigned
              by the AFTR.";

          leaf id {
              type uint16;
              description
                "An identifier";
          }

          uses port-number;
      }

      container port-set {
          description
            "Manages port-set assignments.";

          leaf port-set-enable {
            type boolean;
             description
              "Enable/Disable port set assignment.";
          }

          leaf port-set-size {
            type uint16;
            description
              "Indicates the size of assigned port sets.";
          }

          leaf port-set-timeout {
            type uint32;
            description
            "Inactivty timeout for port sets.";
          }
      }

      leaf enable-app {
          type boolean;
          default true;
```

```
        description
        "Enable/disable the IP address
        pooling behavior of Paired (APP).
        APP is recommended in REQ-2 from
        [RFC4787].";
    }

    leaf max-softwire-per-subscriber {
        type uint8;
        default 1;
        description
        "Configures the maximum softwire per subscriber
        feature as per Section 4 of [RFC7785].
        This policy aims to prevent a misbehaving
        subscriber from mounting several DS-Lite
        softwires that would consume additional AFTR
        resources (e.g., get more external ports if
        the quota were enforced on a per-softwire basis,
        consume extra processing due to a large number
        of active softwires).";
    }

    list transport-protocol {
        key "transport-protocol-id";
        description
          "Set of (transport) protocols supported by
          the AFTR. Default must be set to
          TCP and UDP.";

        leaf transport-protocol-id {
            type uint8;
            description
               "Identifier of the transport protocol.
               IANA Protocol Numbers maintianed in
               http://www.iana.org/assignments/
               protocol-numbers are used.";
        }
    }

    leaf new-mappings-rate-limit {
        type uint32;
        description
         "Rate-limit sessions per subscriber.
         The goal is to prevent a single subscriber
         from consuming excessive CPU resources from
         the AFTR.";
    }
```

```
      leaf mss-clamping-enable {
          type boolean;
          description
            "Enable/disable MSS rewritting feature.";
      }

      leaf port-randomization-enable {
          type boolean;
          description
          "Enable/disable port randomization feature.
          Section 9 of [RFC7857] specifies that a NAT
          should follow the recommendations in
          Section 4 of RFC6056.";
      }

      leaf port-preservation-enable {
          type boolean;
          description
           "Indicates whether the AFTR should
           preserve the internal port number.";
      }

      leaf port-parity-preservation-enable {
          type boolean;
          description
            "Indicates whether the AFTR should
            preserve the port parity of the
            internal port number.
            Section 8 of [RFC7857] indicates that
            a NAT may disable port parity preservation
            for all dynamic mappings.
            It also specifies that a NAT should support
            means to explicitly request to preserve
            port parity (e.g., [RFC7753]).";
      }

      leaf address-roundrobin-enable {
         type boolean;
         description
            "Enable/disable address allocation
            round robin.";
      }

      uses lifetime;

      leaf v6-v4-dscp-preservation {
          type boolean;
          mandatory true;
```

```
          description
           "Copies the DSCP value from the IPv6 header
           and vice versa.
           According to Section 2.10 of [RFC6908],
           operators should use this model
           by provisioning the network such that
           the AFTR copies the DSCP value in the IPv4
           header to the Traffic Class field in
           the IPv6 header, after the encapsulation
           for the downstream traffic.";
      }

      container logging-info {
           description
              "Information about AFTR logging events.";

          leaf logging-enable {
               type boolean;
               description
                 "Enable logging features as per Section 2.3
                 of [RFC6908].";
          }

          leaf destination-address {
               type inet:ip-prefix;
               description
                   "Address of the collector that receives
                   the logs.";
          }

          leaf destination-port {
               type inet:port-number;
               description
                  "Destination port of the collector.";
          }
      }

      container notify-address-pool-usage {
            description
               "Notification of Pool usage when certain criteria
                is met.";

            leaf pool-id {
                 type uint32;
                 description
                     "Pool-ID for which the notification criteria is
                      defined.";
            }
```

```
            leaf notify-pool-hi-threshold {
                 type percent;
                 mandatory true;
                 description
                   "Notification must be generated when the defined
                   high threshold is reached. For example, if a
                   notification is required when the pool utilization
                   reaches 90%, this configuration parameter must be
                   set to 90%.";
            }

            leaf notify-pool-low-threshold {
                 type percent;
                 description
                   "Notification must be generated when the defined
                   low threshold is reached. For example, if a
                   notificationis required when the pool utilization
                   reaches below 10%, this configuration parameter
                   must be set to 10%.";
            }
       }

            leaf ftp-alg-enable {
                 type boolean;
                 description
                    "Enable/Disable FTP ALG.";
            }

            leaf tftp-alg-enable {
                 type boolean;
                 description
                    "Enable/Disable TFTP ALG.";
            }

            leaf sip-alg-enable {
                 type boolean;
                 description
                    "Enable/Disable SIP ALG.";
            }

            leaf rtsp-alg-enable {
                 type boolean;
                 description
                    "Enable/Disable RTSP ALG.";
            }

            leaf h323-alg-enable {
                 type boolean;
```

```
                description
                   "Enable/Disable H323 ALG.";
            }

            leaf all-algs-enable {
                type boolean;
                description
                   "Enable/Disable all the ALGs.";
            }
  }

  // Mapping Entry (Extended NAT44 mapping Entry)

  grouping mapping-entry {
     description
       "A DS-Lite AFTR mapping entry.";

     leaf index {
         type uint32;
         description
           "A unique identifier of a mapping entry.";
     }

     leaf status {
          type enumeration {

          enum "disabled"  {
             description
                "The mapping entry is not in use (Disabled).";
           }

          enum "assigned" {
             description
                "This mapping has been granted by the server.";
          }

          enum "stale" {
             description
                "This is a stale mapping (case of reboot).";
          }
         }
         description
            "Indicates the status of a mapping entry.";
      }

     leaf type {
          type enumeration {
```

```
          enum "static"  {
             description
                "The mapping entry is manually configured.";
            }

          enum "implicit" {
             description
                "This mapping is created by an outgoing packet.";
          }

          enum "explicit" {
             description
              "This is a dynamic explicit mapping created as a result
              of a PCP operation.";
          }
         }
         description
            "Indicates the type of a mapping entry. E.g.,
            a mapping can be: static, dynamic implicit, or
            dynamic explicit.";
      }

      leaf b4-ip-address {
          type inet:ipv6-address;
          mandatory true;
          description
              "Corresponds to the IPv6 address
              used by the B4 element.";
       }

      leaf internal-ip-address {
          type inet:ipv4-prefix;
          mandatory true;
          description
           "Corresponds to the source IPv4 address
            of the IPv4 packet conveyed over the softwire.";
       }

      container internal-port {
          description
             "Corresponds to the source port of the
             IPv4 packet conveyed over the softwire.";
           uses port-number;
      }

     leaf external-ip-address {
          type inet:ipv4-address;
          mandatory true;
```

```
          description
           "External IPv4 address assigned by the AFTR.";
     }

     container external-port {
          description
              "External port number assigned by the AFTR.";
          uses port-number;
     }

     leaf transport-protocol {
         type uint8;
         mandatory true;
         description
           "Upper-layer protocol associated with this mapping.
            Values are taken from the IANA protocol registry.
            For example, this field contains 6 (TCP) for a TCP
            mapping or 17 (UDP) for a UDP mapping.";
     }

     leaf lifetime {
          type uint32;
          mandatory true;
          description
            "Lifetime of the mapping.";
     }

     leaf v6-dscp {
          type uint8;
          description
            "DSCP value used at the softwire level
            (i.e., IPv6 header).";
     }

     leaf internal-v4-dscp {
          type uint8;
          description
            "DSCP value of the enacapsulated IPv4 packet.";
     }

     leaf external-v4-dscp {
          type uint8;
          description
            "DSCP value of the translated IPv4 packet
             as marked by the AFTR.";
     }

     leaf description {
```

```
          type string;
          description
           "A description string associated with the mapping.";
     }
  }

  /*
    * DS-Lite AFTR Configuration
    */

  container dslite-aftr-config {
      description
       "dslite-aftr";

      leaf enable {
          type boolean;
          description
           "Enable/Disable dslite-aftr function.";
      }

      container dslite-aftr-instances {
         description
          "dslite-aftr instances";

          list dslite-aftr-instance {
              key "id";
                description
                  "a dslite-aftr instance.";

             leaf id {
                type uint32;
                description
                  "dslite-aftr instance identifier.";
             }

             leaf name {
                type string;
                description
                  "A name associated with the dslite-aftr instance.";
             }

             uses aftr-parameters;

             container mapping-table {
                description
                  "dslite-aftr mapping table maintained by
                    the dslite-aftr server.";
```

```
                list mapping-entry {
                  key "index";
                  description
                    "dslite-aftr mapping entry.";
                  uses mapping-entry;
                }
              }
            }
        }
    }

    /*
     * DS-Lite AFTR State
     */

    container dslite-aftr-state {

        config false;

        description
           "dslite-aftr";

        container dslite-aftr-instances {
            description
                "dslite-aftr instances";

            list dslite-aftr-instance {
                key "id";

                description
                 "dslite-aftr instance";

                leaf id {
                    type int32;
                     description
                      "The identifier of the dslite-aftr instance.";
                }

                leaf name {
                    type string;
                    description
                     "The name of the dslite-aftr instance.";
                }

                container aftr-capabilities {
                   description
                      "AFTR capabilities";
```

```
                leaf eim-support {
                       type boolean;
                       description
                         "Indicates whether EIM is enabled.";
                }

                leaf eif-support {
                       type boolean;
                       description
                         "Indicates whether EIF is enabled.";
                }

                leaf edm-support {
                       type boolean;
                       description
                         "Indicates whether EDM is enabled.";
                }

                leaf edf-support {
                       type boolean;
                       description
                         "Indicates whether EDF is enabled.";
                }

                leaf adm-support {
                       type boolean;
                       description
                         "Indicates whether ADM is enabled.";
                }

                leaf adf-support {
                       type boolean;
                       description
                         "Indicates whether ADF is enabled.";
                }

                leaf pcp-support {
                       type boolean;
                       description
                         "Indicates whether a PCP server is enabled.";
                }

                leaf subscriber-mask-support{
                    type boolean;
                    description
                      "Indicates whether the subscriber-mask feature
                       is supported.";
                 }
```

```
                leaf port-set-support {
                   type boolean;
                   description
                    "Indicates whether port set assignment is
                    supported.";
                }

                leaf self-state-migration-support {
                   type boolean;
                   description
                    "Indicates whether mappings migration
                    to the new IPv6 address used by the B4 is
                    supported [RFC7785].";
                }

                leaf mss-clamping-support {
                       type boolean;
                       description
                         "Indicates whether the MSS clamping
                         feature is supported.";
                }

                leaf port-randomization-support {
                   type boolean;
                   description
                    "Indicates whether port randomization is
                    supported.";
                }

                leaf port-preservation-support {
                   type boolean;
                   description
                    "Indicates whether port preservation
                    is supported.";
                }

                leaf port-parity-preservation-support {
                   type boolean;
                   description
                    "Indicates whether port parity preservation is
                     supported.";
                }

                list transport-proto-capabilities {
                  key "transport-protocol-id";
                  description
                    "A set of supported transport protocols.";
```

```
                leaf transport-protocol-id {
                   type uint8;
                   description
                     "ID of the transport protocol.";
                }
              }

              leaf v6-v4-dscp-preservation-support {
                     type boolean;
                     description
                       "Copy the DSCP value from the IPv6 header
                       and vice versa.";
              }

              leaf logging-support {
                  type boolean;
                  description
                    "Indicates whether a logging feature is
                    supported.";
              }

         leaf ftp-alg-support {
              type boolean;
              description
                 "Indicates whether FTP ALG is supported.";
         }

         leaf tftp-support {
              type boolean;
              description
                 "Indicates whether TFTP ALG is supported.";
         }

         leaf sip-alg-support {
              type boolean;
              description
                 "Indicates whether SIP ALG is supported.";
         }

         leaf rtsp-alg-support {
              type boolean;
              description
                 "Indicates whether RTSP ALG is supported.";
         }

         leaf h323-alg-support {
              type boolean;
              description
```

```
                "Indicates whether H323 ALG is supported.";
            }
               }

              container aftr-current-config {
                 description
                      "current config";

                 uses aftr-parameters;
              }

              container mapping-table {
                  description
                      "Mapping table";
                  list mapping-entry {
                      key "index";
                      description
                          "mapping entry";
                      uses mapping-entry;
                      }
              }

              container statistics {
                  description
                       "traffic statistics";

                  container traffic-statistics {
                              description
                                "Generic traffic statistics.";

                              leaf sent-packet {
                                type yang:zero-based-counter64;
                                 description
                                  "Number of packets sent.";
                              }

                              leaf sent-byte {
                                type yang:zero-based-counter64;
                                description
                                  "Counter for sent traffic in bytes.";
                              }

                              leaf rcvd-packet {
                                type yang:zero-based-counter64;
                                description
                                   "Number of received packets.";
                              }
```

```
        leaf rcvd-byte {
          type yang:zero-based-counter64;
          description
           "Counter for received traffic
           in bytes.";
        }

        leaf dropped-packet {
          type yang:zero-based-counter64;
          description
           "Number of dropped packets.";
        }

        leaf dropped-byte {
          type yang:zero-based-counter64;
          description
            "Counter for dropped traffic in
            bytes.";
        }
      }

      container mapping-table-stats {
        description
         "Mapping table statistics.";

    leaf current-mt-size {
       type yang:zero-based-counter64;
       description
         "Size of the mapping table.";
       }

       leaf max-mt-size {
         type uint32;
              description
                "Maximum configured size of the
                mapping table.";
        }

         leaf total-tcp-mappings {
              type uint32;
              description
               "Total number of TCP Mappings present
               at the time.";
         }
         leaf total-udp-mappings {
              type uint32;
              description
               "Total number of UDP Mappings present
```

```
                                 at the time.";
                               }

                               leaf total-icmp-mappings {
                                    type uint32;
                                    description
                                     "Total number of ICMP Mappings present
                                     at the time.";
                               }
                             }
                           }

                           leaf available-capacity-client {
                                type percent;
                                description
                                 "Ratio of available capacity in the
                                 customer-facing interfaces.";
                           }

                           leaf available-capacity-ext {
                                type percent;
                                description
                                 "Ratio of available capacity in the
                                 Internet-facing interfaces.";
                           }

                           leaf address-pool-in-use {
                                type percent;
                                description
                                 "Ratio of the shared address pool.";
                           }

                           leaf port-in-use {
                                type percent;
                                description
                                 "Ratio of the port usage.";
                           }
                      }
                 }
            }

            /*
             * Notifications
             */

              notification dslite-aftr-event {

                 description
```

```
        "Notifications must be generated when the defined
        high/low threshold is reached. Related configuration
        parameters must be provided to trigger
        the notifications.";

      leaf id {
          type leafref {
           path
             "/dslite-aftr-state/dslite-aftr-instances/"
             + "dslite-aftr-instance/id";
          }
                description
                  "AFTR instance ID.";
       }

      leaf notify-pool-threshold {
                type percent;
                mandatory true;
                description
                  "A treshhold has been fired.";
       }
   }
  }
  <CODE ENDS>
```

## 4. Security Considerations

The YANG module defined in this memo is designed to be accessed via the NETCONF protocol [RFC6241]. The lowest NETCONF layer is the secure transport layer and the support of SSH is mandatory to implement secure transport [RFC6242]. The NETCONF access control model [RFC6536] provides means to restrict access for particular NETCONF users to a pre-configured subset of all available NETCONF protocol operations and contents.

All data nodes defined in the YANG module which can be created, modified and deleted (i.e., config true, which is the default). These data nodes are considered sensitive. Write operations (e.g., edit-config) applied to these data nodes without proper protection can negatively affect network operations.

## 5. IANA Considerations

This document requests IANA to register the following URI in the "IETF XML Registry" [RFC3688]:

URI: urn:ietf:params:xml:ns:yang:ietf-dslite-aftr
Registrant Contact: The IESG.
XML: N/A; the requested URI is an XML namespace.

This document requests IANA to register the following YANG module in the "YANG Module Names" registry [RFC6020].

name: ietf-dslite-aftr
namespace: urn:ietf:params:xml:ns:yang:ietf-dslite-aftr
prefix: dslite-aftr
reference: RFC XXXX

## 6. Acknowledgements

Thanks to Q. Wu for identifying a compiling error.

## 7. References

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