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Routing Area Common YANG Data Types
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Abstract

This document defines a collection of common data types using the YANG data modeling language. These derived common types are designed to be imported by other modules defined in the routing area.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

The YANG [RFC6020] [RFC7950] is a data modeling language used to model configuration data, state data, Remote Procedure Calls, and notifications for network management protocols. The YANG language supports a small set of built-in data types and provides mechanisms to derive other types from the built-in types.

This document introduces a collection of common data types derived from the built-in YANG data types. The derived types are designed to be the common types applicable for modeling in the routing area.

1.1. Terminology

The terminology for describing YANG data models is found in [RFC7950].

2. Overview

This document defines the two models for common routing types, ietf-routing-types and iana-routing-types. The only module imports are from [RFC6991]. The ietf-routing-types model contains common routing types other than those corresponding directly to IANA mappings. These include:

router-id

Router Identifiers are commonly used to identify a nodes in routing and other control plane protocols. An example usage of router-id can be found in [I-D.ietf-ospf-yang].

route-target
Route Targets (RTs) are commonly used to control the distribution of virtual routing and forwarding (VRF) information, see [RFC4364], in support of virtual private networks (VPNs). An example usage can be found in [I-D.ietf-bess-l2vpn-yang].

ipv6-route-target
IPv6 Route Targets (RTs) are similar to standard Route Targets only they IPv6 Address Specific BGP Extended Communities as described in [RFC5701]. An IPv6 Route Target is 20 octets and includes an IPv6 address as the global administrator.

route-target-type
This type defines the import and export rules of Route Targets, as descibed in Section 4.3.1 of [RFC4364]. An example usage can be found in [I-D.ietf-idr-bgp-model].

route-distinguisher
Route Distinguishers (RDs) are commonly used to identify separate routes in support of virtual private networks (VPNs). For example, in [RFC4364], RDs are commonly used to identify independent VPNs and VRFs, and more generally, to identify multiple routes to the same prefix. An example usage can be found in [I-D.ietf-idr-bgp-model].

route-origin
Route Origin is commonly used to indicate the Site of Origin for Routng and forwarding (VRF) information, see [RFC4364], in support of virtual private networks (VPNs). An example usage can be found in [I-D.ietf-bess-l3vpn-yang].

ipv6-route-origin
An IPv6 Route Origin would also be used to indicate the Site of Origin for Routng and forwarding (VRF) information, see [RFC4364], in support of virtual private networks (VPNs). IPv6 Route Origins are IPv6 Address Specific BGP Extended Communities as described in [RFC5701]. An IPv6 Route Origin is 20 octets and includes an IPv6 address as the global administrator.

ipv4-multicast-group-address
This type defines the representation of an IPv4 multicast group address, which is in the range from 224.0.0.0 to 239.255.255.255. An example usage can be found in [I-D.ietf-pim-yang].

ipv6-multicast-group-address
: This type defines the representation of an IPv6 multicast group address, which is in the range of FF00::/8. An example usage can be found in [I-D.ietf-pim-yang].

ip-multicast-group-address
: This type represents an IP multicast group address and is IP version neutral. The format of the textual representation implies the IP version. An example usage can be found in [I-D.ietf-pim-yang].

ipv4-multicast-source-address
: IPv4 source address type for use in multicast control protocols. This type also allows the indication of wildcard sources, i.e., "*". An example of where this type may/will be used is [I-D.ietf-pim-yang].

ipv6-multicast-source-address
: IPv6 source address type for use in multicast control protocols. This type also allows the indication of wildcard sources, i.e., "*". An example of where this type may/will be used is [I-D.ietf-pim-yang].

bandwidth-ieee-float32
: Bandwidth in IEEE 754 floating point 32-bit binary format [IEEE754]. Commonly used in Traffic Engineering control plane protocols. An example of where this type may/will be used is [I-D.ietf-ospf-yang].

link-access-type
: This type identifies the IGP link type. An example of where this type may/will be used is [I-D.ietf-ospf-yang].

timer-multiplier
: This type is used in conjunction with a timer-value type. It is generally used to indicate define the number of timer-value intervals that may expire before a specific event must occur. Examples of this include the arrival of any BFD packets, see [RFC5880] Section 6.8.4, or hello_interval in [RFC3209]. Example of where this type may/will be used is [I-D.ietf-idr-bgp-model] and [I-D.ietf-teas-yang-rsvp].

timer-value-seconds16
: This type covers timers which can be set in seconds, not set, or set to infinity. This type supports a range of values that can be represented in a uint16 (2 octets). An example of where this type may/will be used is [I-D.ietf-ospf-yang].

timer-value-seconds32
: This type covers timers which can be set in seconds, not set, or set to infinity. This type supports a range of values that can be represented in a uint32 (4 octets). An example of where this type may/will be used is [I-D.ietf-teas-yang-rsvp].

timer-value-milliseconds
: This type covers timers which can be set in milliseconds, not set, or set to infinity. This type supports a range of values that can be represented in a uint32 (4 octets). Examples of where this type may/will be used include [I-D.ietf-teas-yang-rsvp] and [I-D.ietf-bfd-yang].

percentage
: This type defines a percentage with a range of 0-100%. An example usage can be found in [I-D.ietf-idr-bgp-model].

timeticks64
: This type is based on the timeticks type defined in [RFC6991] but with 64-bit precision. It represents the time in hundredths of a second between two epochs. An example usage can be found in [I-D.ietf-idr-bgp-model].

uint24
: This type defines a 24-bit unsigned integer. It is used by target="I-D.ietf-ospf-yang"/>.

generalized-label
: This type represents a generalized label for Generalized Multi-Protocol Label Switching (GMPLS) [RFC3471]. The Generalized Label does not identify its type, which is known from the context. An example usage can be found in [I-D.ietf-teas-yang-te].

mpls-label-special-purpose
: This type represents the special-purpose Multiprotocol Label Switching (MPLS) label values [RFC7274]. An example usage can be found in [I-D.ietf-mpls-base-yang].

mpls-label-general-use
: The 20 bits label values in an MPLS label stack entry, specified in [RFC3032]. This label value does not include the encodings of Traffic Class and TTL (time to live). The label range specified by this type is for general use, with special-purpose MPLS label values excluded. An example usage can be found in [I-D.ietf-mpls-base-yang].

mpls-label

The 20 bits label values in an MPLS label stack entry, specified in [RFC3032]. This label value does not include the encodings of Traffic Class and TTL (time to live). The label range specified by this type covers the general use values and the special-purpose label values. An example usage can be found in [I-D.ietf-mpls-base-yang].

This document defines the following YANG groupings:

mpls-label-stack
: This grouping defines a reusable collection of schema nodes representing an MPLS label stack [RFC3032]. An example usage can be found in [I-D.ietf-mpls-base-yang].

vpn-route-targets
: This grouping defines a reusable collection of schema nodes representing Route Target import-export rules used in the BGP enabled Virtual Private Networks (VPNs). [RFC4364][RFC4664]. An example usage can be found in [I-D.ietf-bess-l2vpn-yang].

geo-coordinates
: This grouping defines a reusable collection of schema nodes representing the Geo-coordinates in IETF models. The schema modes specify the location of an object using the WGS-84 (World Geodetic System) reference coordinate system [WGS84]. This is expected to used in augmentations to routing protocol models such as [I-D.ietf-ospf-yang].

The iana-routing-types model contains common routing types corresponding directly to IANA mappings. These include:

address-family
: This type defines values for use in address family identifiers. The values are based on the IANA Address Family Numbers Registry [IANA-ADDRESS-FAMILY-REGISTRY]. An example usage can be found in [I-D.ietf-idr-bgp-model].

subsequent-address-family
: This type defines values for use in subsequent address family (SAFI) identifiers. The values are based on the IANA Subsequent Address Family Identifiers (SAFI) Parameters Registry [IANA-SAFI-REGISTRY].

3. IETF Routing Types YANG Module

```
<CODE BEGINS> file "ietf-routing-types@2017-06-29.yang"
module ietf-routing-types {
  namespace "urn:ietf:params:xml:ns:yang:ietf-routing-types";
```

```
    prefix rt-types;

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

    organization
      "IETF RTGWG - Routing Area Working Group";
    contact
      "WG Web:   <http://tools.ietf.org/wg/rtgwg/>
       WG List:  <mailto:rtgwg@ietf.org>

       Editor:   Xufeng Lui
                 <mailto:Xufeng_Lui@jabail.com>
                 Yingzhen Qu
                 <mailto:yingzhen.qu@huawei.com>
                 Acee Lindem
                 <mailto:acee@cisco.com>
                 Christian Hopps
                 <mailto:chopps@chopps.org>
                 Lou Berger
                 <mailto:lberger@labn.com>";
    description
      "This module contains a collection of YANG data types
       considered generally useful for routing protocols.

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       identified as authors of the code.  All rights reserved.

       Redistribution and use in source and binary forms, with or
       without modification, is permitted pursuant to, and subject
       to the license terms contained in, the Simplified BSD License
       set forth in Section 4.c of the IETF Trust's Legal Provisions
       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.";
    reference "RFC XXXX";

    revision 2017-06-29 {
      description
        "Initial revision.";
      reference "RFC TBD: Routing YANG Data Types";
    }
```

```
    /*** Identities related to MPLS/GMPLS ***/

    identity mpls-label-special-purpose-value {
      description
        "Base identity for deriving identities describing
         special-purpose Multiprotocol Label Switching (MPLS) label
         values.";
      reference
        "RFC7274: Allocating and Retiring Special-Purpose MPLS
         Labels.";
    }

    identity ipv4-explicit-null-label {
      base mpls-label-special-purpose-value;
      description
        "This identity represents the IPv4 Explicit NULL Label.";
      reference "RFC3032: MPLS Label Stack Encoding. Section 2.1.";
    }

    identity router-alert-label {
      base mpls-label-special-purpose-value;
      description
        "This identity represents the Router Alert Label.";
      reference "RFC3032: MPLS Label Stack Encoding. Section 2.1.";
    }

    identity ipv6-explicit-null-label {
      base mpls-label-special-purpose-value;
      description
        "This identity represents the IPv6 Explicit NULL Label.";
      reference "RFC3032: MPLS Label Stack Encoding. Section 2.1.";
    }

    identity implicit-null-label {
      base mpls-label-special-purpose-value;
      description
        "This identity represents the Implicit NULL Label.";
      reference "RFC3032: MPLS Label Stack Encoding. Section 2.1.";
    }

    identity entropy-label-indicator {
      base mpls-label-special-purpose-value;
      description
        "This identity represents the Entropy Label Indicator.";
      reference
        "RFC6790: The Use of Entropy Labels in MPLS Forwarding.
         Sections 3 and 10.1.";
    }
```

```
    identity gal-label {
      base mpls-label-special-purpose-value;
      description
        "This identity represents the Generic Associated Channel
         Label (GAL).";
      reference
        "RFC5586: MPLS Generic Associated Channel.
         Sections 4 and 10.";
    }

    identity oam-alert-label {
      base mpls-label-special-purpose-value;
      description
        "This identity represents the OAM Alert Label.";
      reference
        "RFC3429: Assignment of the 'OAM Alert Label' for
         Multiprotocol Label Switching Architecture (MPLS)
         Operation and Maintenance (OAM) Functions.
         Sections 3 and 6.";
    }

    identity extension-label {
      base mpls-label-special-purpose-value;
      description
        "This identity represents the Extension Label.";
      reference
        "RFC7274: Allocating and Retiring Special-Purpose MPLS
         Labels.  Sections 3.1 and 5.";
    }

    /*** Collection of types related to routing ***/

    typedef router-id {
      type yang:dotted-quad;
      description
        "A 32-bit number in the dotted quad format assigned to each
         router. This number uniquely identifies the router within
         an Autonomous System.";
    }

    /*** Collection of types related to VPN ***/

    typedef route-target {
      type string {
        pattern
          '(0:(6553[0-5]|655[0-2]\d|65[0-4]\d{2}|6[0-4]\d{3}|'
        + '[0-5]?\d{0,3}\d):(429496729[0-5]|42949672[0-8]\d|'
        + '4294967[01]\d{2}|429496[0-6]\d{3}|42949[0-5]\d{4}|'
```

```
        + '4294[0-8]\d{5}|429[0-3]\d{6}|42[0-8]\d{7}|4[01]\d{8}|'
        + '[0-3]?\d{0,8}\d))|'
        + '(1:(((\d|[1-9]\d|1\d{2}|2[0-4]\d|25[0-5])\.){3}(\d|[1-9]\d|'
        + '1\d{2}|2[0-4]\d|25[0-5])):(6553[0-5]|655[0-2]\d|'
        + '65[0-4]\d{2}|6[0-4]\d{3}|[0-5]?\d{0,3}\d))|'
        + '(2:(429496729[0-5]|42949672[0-8]\d|4294967[01]\d{2}|'
        + '429496[0-6]\d{3}|42949[0-5]\d{4}|4294[0-8]\d{5}|'
        + '429[0-3]\d{6}|42[0-8]\d{7}|4[01]\d{8}|[0-3]?\d{0,8}\d):'
        + '(6553[0-5]|655[0-2]\d|65[0-4]\d{2}|6[0-4]\d{3}|'
        + '[0-5]?\d{0,3}\d))';
      }
      description
        "A route target is an 8-octet BGP extended community
         initially identifying a set of sites in a BGP
         VPN (RFC 4364). However, it has since taken on a more
         general role in BGP route filtering.
         A route target consists of three fields:
         a 2-octet type field, an administrator field,
         and an assigned number field.
         According to the data formats for type 0, 1, and 2 defined
         in RFC4360 and RFC5668, the encoding pattern is defined as:

         0:2-octet-asn:4-octet-number
         1:4-octet-ipv4addr:2-octet-number
         2:4-octet-asn:2-octet-number.

         Some valid examples are: 0:100:100, 1:1.1.1.1:100, and
         2:1234567890:203.";
      reference
        "RFC4360: BGP Extended Communities Attribute.
         RFC5668: 4-Octet AS Specific BGP Extended Community.";
    }

    typedef ipv6-route-target {
      type string {
        pattern
            '((:|[0-9a-fA-F]{0,4}):)([0-9a-fA-F]{0,4}:){0,5}'
            + '((([0-9a-fA-F]{0,4}:)?(:|[0-9a-fA-F]{0,4}))|'
            + '(((25[0-5]|2[0-4][0-9]|[01]?[0-9]?[0-9])\.){3}'
            + '(25[0-5]|2[0-4][0-9]|[01]?[0-9]?[0-9])))'
            + ':'
            + '(6553[0-5]|655[0-2]\d|65[0-4]\d{2}|6[0-4]\d{3}|'
            + '[0-5]?\d{0,3}\d)';
        pattern '((([^:]+:){6}(([^:]+:[^:]+)|(.*\..*)))|'
            + '((([^:]+:)*[^:]+)?::(([^:]+:)*[^:]+)?))'
            + ':'
            + '(6553[0-5]|655[0-2]\d|65[0-4]\d{2}|6[0-4]\d{3}|'
            + '[0-5]?\d{0,3}\d)';
```

```
      }
      description
        "An IPv6 route target is a 20-octet BGP IPv6 address
         specific extended community serving the same function
         as a standard 8-octet route target only allowing for
         an IPv6 address as the global adminstrator. The format
         is <ipv6-address:2-octet-number>.

         Some valid examples are: 2001:DB8::1:6544 and
         2001:DB8::5eb1:791:6b37:17958";
      reference
        "RFC5701: IPv6 Address Specific BGP Extended Community
                  Attribute";
    }

    typedef route-target-type {
      type enumeration {
        enum "import" {
          value 0;
          description
            "The route target applies to route import.";
        }
        enum "export" {
          value 1;
          description
            "The route target applies to route export.";
        }
        enum "both" {
          value 2;
          description
            "The route target applies to both route import and
             route export.";
        }
      }
      description
        "Indicates the role a route target takes
         in route filtering.";
      reference "RFC4364: BGP/MPLS IP Virtual Private Networks (VPNs).";
    }

    typedef route-distinguisher {
      type string {
        pattern
          '(0:(6553[0-5]|655[0-2]\d|65[0-4]\d{2}|6[0-4]\d{3}|'
        + '[0-5]?\d{0,3}\d):(429496729[0-5]|42949672[0-8]\d|'
        + '4294967[01]\d{2}|429496[0-6]\d{3}|42949[0-5]\d{4}|'
        + '4294[0-8]\d{5}|429[0-3]\d{6}|42[0-8]\d{7}|4[01]\d{8}|'
        + '[0-3]?\d{0,8}\d))|'
```

```
        + '(1:(((\d|[1-9]\d|1\d{2}|2[0-4]\d|25[0-5])\.){3}(\d|[1-9]\d|'
        + '1\d{2}|2[0-4]\d|25[0-5])):(6553[0-5]|655[0-2]\d|'
        + '65[0-4]\d{2}|6[0-4]\d{3}|[0-5]?\d{0,3}\d))|'
        + '(2:(429496729[0-5]|42949672[0-8]\d|4294967[01]\d{2}|'
        + '429496[0-6]\d{3}|42949[0-5]\d{4}|4294[0-8]\d{5}|'
        + '429[0-3]\d{6}|42[0-8]\d{7}|4[01]\d{8}|[0-3]?\d{0,8}\d):'
        + '(6553[0-5]|655[0-2]\d|65[0-4]\d{2}|6[0-4]\d{3}|'
        + '[0-5]?\d{0,3}\d))|'
        + '(([3-9a-fA-F]|[1-9a-fA-F][\da-fA-F]{1,3}):'
        + '[\da-fA-F]{1,12})';
      }
      description
        "A route distinguisher is an 8-octet value used to distinguish
         routes from different BGP VPNs (RFC 4364). A route
         distinguisher consists of three fields: A 2-octet type field,
         an administrator field, and an assigned number field.
         According to the data formats for type 0, 1, and 2 defined in
         RFC4364, the encoding pattern is defined as:

         0:2-octet-asn:4-octet-number
         1:4-octet-ipv4addr:2-octet-number
         2:4-octet-asn:2-octet-number.
         2-octet-other-hex-number:6-octet-hex-number

         Some valid examples are: 0:100:100, 1:1.1.1.1:100, and
         2:1234567890:203.";
      reference "RFC4364: BGP/MPLS IP Virtual Private Networks (VPNs).";
    }

    typedef route-origin {
      type string {
        pattern
          '(0:(6553[0-5]|655[0-2]\d|65[0-4]\d{2}|6[0-4]\d{3}|'
        + '[0-5]?\d{0,3}\d):(429496729[0-5]|42949672[0-8]\d|'
        + '4294967[01]\d{2}|429496[0-6]\d{3}|42949[0-5]\d{4}|'
        + '4294[0-8]\d{5}|429[0-3]\d{6}|42[0-8]\d{7}|4[01]\d{8}|'
        + '[0-3]?\d{0,8}\d))|'
        + '(1:(((\d|[1-9]\d|1\d{2}|2[0-4]\d|25[0-5])\.){3}(\d|[1-9]\d|'
        + '1\d{2}|2[0-4]\d|25[0-5])):(6553[0-5]|655[0-2]\d|'
        + '65[0-4]\d{2}|6[0-4]\d{3}|[0-5]?\d{0,3}\d))|'
        + '(2:(429496729[0-5]|42949672[0-8]\d|4294967[01]\d{2}|'
        + '429496[0-6]\d{3}|42949[0-5]\d{4}|4294[0-8]\d{5}|'
        + '429[0-3]\d{6}|42[0-8]\d{7}|4[01]\d{8}|[0-3]?\d{0,8}\d):'
        + '(6553[0-5]|655[0-2]\d|65[0-4]\d{2}|6[0-4]\d{3}|'
        + '[0-5]?\d{0,3}\d))|'
        + '(([3-9a-fA-F]|[1-9a-fA-F][\da-fA-F]{1,3}):'
        + '[\da-fA-F]{1,12})';
      }
```

```
      description
        "A route origin is an 8-octet BGP extended community
         identifying the set of sites where the BGP route
         originated(RFC 4364). A route origin consists of three
         fields: A 2-octet type field,  an administrator field,
         and an assigned number field. According to the data
         formats for type 0, 1, and 2 defined in RFC4364,
         the encoding pattern is defined as:

         0:2-octet-asn:4-octet-number
         1:4-octet-ipv4addr:2-octet-number
         2:4-octet-asn:2-octet-number.
         2-octet-other-hex-number:6-octet-hex-number

         Some valid examples are: 0:100:100, 1:1.1.1.1:100, and
         2:1234567890:203.";
      reference
        "RFC4360: BGP Extended Communities Attribute.
         RFC4369: BGP/MPLS IP Virtual Private Networks (VPNs)
         RFC5668: 4-Octet AS Specific BGP Extended Community.";
    }

    typedef ipv6-route-origin {
      type string {
        pattern
            '((:|[0-9a-fA-F]{0,4}):)([0-9a-fA-F]{0,4}:){0,5}'
            + '((([0-9a-fA-F]{0,4}:)?(:|[0-9a-fA-F]{0,4}))|'
            + '(((25[0-5]|2[0-4][0-9]|[01]?[0-9]?[0-9])\.){3}'
            + '(25[0-5]|2[0-4][0-9]|[01]?[0-9]?[0-9])))'
            + ':'
            + '(6553[0-5]|655[0-2]\d|65[0-4]\d{2}|6[0-4]\d{3}|'
            + '[0-5]?\d{0,3}\d)';
        pattern '((([^:]+:){6}(([^:]+:[^:]+)|(.*\..*)))|'
            + '((([^:]+:)*[^:]+)?::(([^:]+:)*[^:]+)?))'
            + ':'
            + '(6553[0-5]|655[0-2]\d|65[0-4]\d{2}|6[0-4]\d{3}|'
            + '[0-5]?\d{0,3}\d)';
      }
      description
        "An IPv6 route origin is a 20-octet BGP IPv6 address
         specific extended community serving the same function
         as a standard 8-octet route only only allowing for
         an IPv6 address as the global adminstrator. The format
         is <ipv6-address:2-octet-number>.

         Some valid examples are: 2001:DB8::1:6544 and
         2001:DB8::5eb1:791:6b37:17958";
      reference
```

```
        "RFC5701: IPv6 Address Specific BGP Extended Community
                  Attribute";
    }

    /*** Collection of types common to multicast ***/

    typedef ipv4-multicast-group-address {
      type inet:ipv4-address {
        pattern '(2((2[4-9])|(3[0-9]))\.).*';
      }
      description
        "This type represents an IPv4 multicast group address,
         which is in the range from 224.0.0.0 to 239.255.255.255.";
      reference "RFC1112: Host Extensions for IP Multicasting.";
    }

    typedef ipv6-multicast-group-address {
      type inet:ipv6-address {
        pattern
          '(([fF]{2}[0-9a-fA-F]{2}):).*';
      }
      description
        "This type represents an IPv6 multicast group address,
         which is in the range of FF00::/8.";
      reference
        "RFC4291: IP Version 6 Addressing Architecture. Sec 2.7.
         RFC7346: IPv6 Multicast Address Scopes.";
    }

    typedef ip-multicast-group-address {
      type union {
        type ipv4-multicast-group-address;
        type ipv6-multicast-group-address;
      }
      description
        "This type represents a version-neutral IP multicast group
         address. The format of the textual representation implies
         the IP version.";
    }

    typedef ipv4-multicast-source-address {
      type union {
        type enumeration {
          enum "*" {
            description
              "Any source address.";
          }
        }
```

```
        type inet:ipv4-address;
      }
      description
        "Multicast source IPv4 address type.";
    }

    typedef ipv6-multicast-source-address {
      type union {
        type enumeration {
          enum "*" {
            description
              "Any source address.";
          }
        }
        type inet:ipv6-address;
      }
      description
        "Multicast source IPv6 address type.";
    }

    /*** Collection of types common to protocols ***/

    typedef bandwidth-ieee-float32 {
      type string {
        pattern
          '0[xX](0((\.0?)?[pP](\+)?0?|(\.0?))|'
        + '1(\.([\da-fA-F]{0,5}[02468aAcCeE]?)?)?[pP](\+)?(12[0-7]|'
        + '1[01]\d|0?\d?\d)?)';
      }
      description
        "Bandwidth in IEEE 754 floating point 32-bit binary format:
         (-1)**(S) * 2**(Exponent-127) * (1 + Fraction),
         where Exponent uses 8 bits, and Fraction uses 23 bits.
         The units are octets per second.
         The encoding format is the external hexadecimal-significant
         character sequences specified in IEEE 754 and C99. The
         format is restricted to be normalized, non-negative, and
         non-fraction: 0x1.hhhhhhp{+}d or 0X1.HHHHHHP{+}D
         where 'h' and 'H' are hexadecimal digits, 'd' and 'D' are
         integers in the range of [0..127].
         When six hexadecimal digits are used for 'hhhhhh' or 'HHHHHH',
         the least significant digit must be an even number.
         'x' and 'X' indicate hexadecimal; 'p' and 'P' indicate power
         of two. Some examples are: 0x0p0, 0x1p10, and
         0x1.abcde2p+20";
      reference
        "IEEE Std 754-2008: IEEE Standard for Floating-Point
         Arithmetic.";
```

```
    }

    typedef link-access-type {
      type enumeration {
        enum "broadcast" {
          description
            "Specify broadcast multi-access network.";
        }
        enum "non-broadcast-multiaccess" {
          description
            "Specify Non-Broadcast Multi-Access (NBMA) network.";
        }
        enum "point-to-multipoint" {
          description
            "Specify point-to-multipoint network.";
        }
        enum "point-to-point" {
          description
            "Specify point-to-point network.";
        }
      }
      description
        "Link access type.";
    }

    typedef timer-multiplier {
      type uint8;
      description
        "The number of timer value intervals that should be
         interpreted as a failure.";
    }

    typedef timer-value-seconds16 {
      type union {
        type uint16 {
          range "1..65535";
        }
        type enumeration {
          enum "infinity" {
            description
              "The timer is set to infinity.";
          }
          enum "not-set" {
            description
              "The timer is not set.";
          }
        }
      }
```

```
      units "seconds";
      description
        "Timer value type, in seconds (16-bit range).";
    }

    typedef timer-value-seconds32 {
      type union {
        type uint32 {
          range "1..4294967295";
        }
        type enumeration {
          enum "infinity" {
            description
              "The timer is set to infinity.";
          }
          enum "not-set" {
            description
              "The timer is not set.";
          }
        }
      }
      units "seconds";
      description
        "Timer value type, in seconds (32-bit range).";
    }

    typedef timer-value-milliseconds {
      type union {
        type uint32 {
          range "1..4294967295";
        }
        type enumeration {
          enum "infinity" {
            description
              "The timer is set to infinity.";
          }
          enum "not-set" {
            description
              "The timer is not set.";
          }
        }
      }
      units "milliseconds";
      description
        "Timer value type, in milliseconds.";
    }

    typedef percentage {
```

```
      type uint8 {
        range "0..100";
      }
      description
        "Integer indicating a percentage value";
    }

    typedef timeticks64 {
      type uint64;
      description
        "This type is based on the timeticks type defined in
         RFC 6991, but with 64-bit width.  It represents the time,
         modulo 2^64, in hundredths of a second between two epochs.";
      reference "RFC 6991 - Common YANG Data Types";
    }

    typedef uint24 {
      type uint32 {
        range "0 .. 16777215";
      }
      description
        "24-bit unsigned integer";
    }

    /*** Collection of types related to MPLS/GMPLS ***/

    typedef generalized-label {
      type binary;
      description
        "Generalized label. Nodes sending and receiving the
         Generalized Label are aware of the link-specific
         label context and type.";
      reference "RFC3471: Section 3.2";
    }

    typedef mpls-label-special-purpose {
      type identityref {
        base mpls-label-special-purpose-value;
      }
      description
        "This type represents the special-purpose Multiprotocol Label
         Switching (MPLS) label values.";
      reference
        "RFC3032: MPLS Label Stack Encoding.
         RFC7274: Allocating and Retiring Special-Purpose MPLS
         Labels.";
    }
```

```
    typedef mpls-label-general-use {
      type uint32 {
        range "16..1048575";
      }
      description
        "The 20-bit label values in an MPLS label stack entry,
         specified in RFC3032. This label value does not include
         the encodings of Traffic Class and TTL (time to live).
         The label range specified by this type is for general use,
         with special-purpose MPLS label values excluded.";
      reference "RFC3032: MPLS Label Stack Encoding.";
    }

    typedef mpls-label {
      type union {
        type mpls-label-special-purpose;
        type mpls-label-general-use;
      }
      description
        "The 20-bit label values in an MPLS label stack entry,
         specified in RFC3032. This label value does not include
         the encodings of Traffic Class and TTL (time to live).";
      reference "RFC3032: MPLS Label Stack Encoding.";
    }

    /*** Groupings **/

    grouping mpls-label-stack {
      description
        "A grouping that specifies an MPLS label stack.";
      container mpls-label-stack {
        description
          "Container for a list of MPLS label stack entries.";
        list entry {
          key "id";
          description
            "List of MPLS label stack entries.";
          leaf id {
            type uint8;
            description
              "Identifies the sequence of an MPLS label stack entries.
               An entry with smaller ID value is precedes an entry in
               the label stack with a smaller ID.";
          }
          leaf label {
            type rt-types:mpls-label;
            description
              "Label value.";
```

```
          }
          leaf ttl {
            type uint8;
            description
              "Time to Live (TTL).";
            reference "RFC3032: MPLS Label Stack Encoding.";
          }
          leaf traffic-class {
            type uint8 {
              range "0..7";
            }
            description
              "Traffic Class (TC).";
            reference
              "RFC5462: Multiprotocol Label Switching (MPLS) Label
               Stack Entry: 'EXP' Field Renamed to 'Traffic Class'
               Field.";
          }
        }
      }
    }

    grouping vpn-route-targets {
      description
        "A grouping that specifies Route Target import-export rules
         used in the BGP enabled Virtual Private Networks (VPNs).";
      reference
        "RFC4364: BGP/MPLS IP Virtual Private Networks (VPNs).
         RFC4664: Framework for Layer 2 Virtual Private Networks
         (L2VPNs)";
      list vpn-target {
        key "route-target";
        description
          "List of Route Targets.";
        leaf route-target {
          type rt-types:route-target;
          description
            "Route Target value";
        }
        leaf route-target-type {
          type rt-types:route-target-type;
          mandatory true;
          description
            "Import/export type of the Route Target.";
        }
      }
    }
```

```
    grouping geo-coordinates {
      description
        "Standard grouping for Geo Coordinates
         in routing information";
      container geo-coordinates {
        description
          "Container for Geo Coordinates";
        leaf flags {
          type bits {
            bit U {
              description
                "If the U-bit is set, it indicates that
                 the location-uncertainty is specified, If the
                 U-bit is clear, it indicates the
                 location-uncertainty is unspecified.";
            }
            bit N {
              description
                "If the N-bit is set, it indicates the
                 latitude is north relative to the Equator. If
                 the N-bit is clear, it indicates the latitude
                 is south of the Equator.";
            }
            bit E {
              description
                "If the E-bit is set, it indicates the
                 longitute is east of the Prime Meridian. If
                 the E-bit is clear, it indicates the longitude
                 is west of the Prime Meridian.";
            }
            bit A {
              description
                "If the A-bit is set, it indicates the
                 altitude is specified. If the A-bit is clear,
                 it indicates the altitude is unspecified.";
            }
            bit M {
              description
                "If the M-bit is set, it indicates the
                 altitude is specified in meters. If the M-bit
                 is clear, it indicates the altitude is
                 specified in centimeters.";
            }
            bit R {
              description
                "If the R-bit is set, it indicates the
                 radius is specified and the encoding is for a
                 circular area. If the R-bit is clear, it
```

```
                indicates the radius is unspecified and the
                encoding is for a single point.";
            }
            bit K {
              description
                "If the R-bit is set, it indicates the
                 radius is specified in kilometers. If the
                 R-bit is clear, it indicates the radius is
                 specified in meters.";
            }
          }
          description
            "Bits defining granularity or semantics
             of Geo Coordinates fields.";
        }
        leaf location-uncertainty {
          type uint16;
          description
            "Number of centimeters of uncertainty for
             the location.";
        }
        leaf latitude-degrees {
          type uint8 {
            range "0 .. 90";
          }
          description
            "Latitude degrees north or south of the
             Equator (northern or southern hemisphere,
             respectively).";
        }
        leaf latitude-milliseconds {
          type uint24 {
            range "0 .. 3599999";
          }
          description
            "Latitude millisecond granularity (less
             than 60 minutes or a single degree).";
        }
        leaf longitude-degrees {
          type uint8 {
            range "0 .. 180";
          }
          description
            "Longitude degrees east or westof the
             Prime Meridian (eastern or western hemisphere,
             respectively).";
        }
        leaf longitude-milliseconds {
```

```
          type uint24 {
            range "0 .. 3599999";
          }
          description
            "Longitude millisecond granularity (less
             than 60 minutes or a single degree).";
        }
        leaf altitude {
          type int32;
          description
            "Height relative to sea level in
             centimeters or meters.  A negative height
             indicates that the location is below sea
             level.";
        }
        leaf radius {
          type uint16;
          description
            "Radius of a circle centered at the
             specified coordinates. The radius is specified
             in meters unless the K-bit is specified
             indicating specification in kilometers. If the
             radius is specified, the geo-coordinates specify
             the entire area of the circle defined by the
             radius and center point.";
        }
      }
    }
  }
```

<CODE ENDS>

4. IANA Routing Types YANG Module

```
<CODE BEGINS> file "iana-routing-types@2017-06-29.yang"
module iana-routing-types {
  namespace "urn:ietf:params:xml:ns:yang:iana-routing-types";
  prefix iana-rt-types;

  organization
    "IANA";
  contact
    "        Internet Assigned Numbers Authority

     Postal: ICANN
             4676 Admiralty Way, Suite 330
             Marina del Rey, CA 90292
```

```
      Tel:    +1 310 823 9358
      <mailto:iana@iana.org>";
    description
      "This module contains a collection of YANG data types
       considered defined by IANA and used for routing
       protocols.

       Copyright (c) 2017 IETF Trust and the persons
       identified as authors of the code.  All rights reserved.

       Redistribution and use in source and binary forms, with or
       without modification, is permitted pursuant to, and subject
       to the license terms contained in, the Simplified BSD License
       set forth in Section 4.c of the IETF Trust's Legal Provisions
       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.";
    reference "RFC XXXX";

    revision 2017-06-29 {
      description
        "Initial revision.";
      reference "RFC TBD: IANA Routing YANG Data Types";
    }

    /*** Collection of IANA types related to routing ***/
    /*** IANA address family Identities ***/

    identity address-family {
      description
        "Base identity from which identities describing address
         families are derived.";
    }

    identity ipv4 {
      base address-family;
      description
        "IPv4 Address Family - IANA Registry Assigned Number: 1";
    }

    identity ipv6 {
      base address-family;
      description
        "IPv6 Address Family - IANA Registry Assigned Number: 2";
    }
```

```
     identity nsap {
       base address-family;
       description
         "OSI Network Service Access Point (NSAP) Address Family -
          IANA Registry Assigned Number: 3";
     }

     identity hdlc {
       base address-family;
       description
         "High-Level Data Link Control (HDLC) Address Family -
          IANA Registry Assigned Number: 4";
     }

     identity bbn1822 {
       base address-family;
       description
         "Bolt, Beranek, and Newman Report 1822 (BBN 1822)
          Address Family - IANA Registry Assigned Number: 5";
     }

     identity ieee802 {
       base address-family;
       description
         "IEEE 802 Committee Address Family (aka, MAC address) -
          IANA Registry Assigned Number: 6";
     }

     identity e163 {
       base address-family;
       description
         "ITU-T E.163 Address Family -
          IANA Registry Assigned Number: 7";
     }

     identity e164 {
       base address-family;
       description
         "ITU-T E.164 (SMDS, Frame Relay, ATM) Address Family -
          IANA Registry Assigned Number: 8";
     }

     identity f69 {
       base address-family;
       description
         "ITU-T F.69 (Telex) Address Family -
          IANA Registry Assigned Number: 9";
     }
```

```
     identity x121 {
       base address-family;
       description
         "ITU-T X.121 (X.25, Frame Relay) Address Family -
          IANA Registry Assigned Number: 10";
     }

     identity ipx {
       base address-family;
       description
         "Novell Internetwork Packet Exchange (IPX)
          Address Family - IANA Registry Assigned Number: 11";
     }

     identity appletalk {
       base address-family;
       description
         "Apple AppleTalk Address Family -
          IANA Registry Assigned Number: 12";
     }

     identity decnet-iv {
       base address-family;
       description
         "Digital Equipment DECnet Phase IV Address Family -
          IANA Registry Assigned Number: 13";
     }

     identity vines {
       base address-family;
       description
         "Banyan Vines Address Family -
          IANA Registry Assigned Number: 14";
     }

     identity e164-nsap {
       base address-family;
       description
         "ITU-T E.164 with NSAP sub-address Address Family -
          IANA Registry Assigned Number: 15";
     }

     identity dns {
       base address-family;
       description
         "Domain Name System (DNS) Address Family -
          IANA Registry Assigned Number: 16";
     }
```

```
     identity distinguished-name {
       base address-family;
       description
         "Distinguished Name Address Family -
          IANA Registry Assigned Number: 17";
     }

     identity as-num {
       base address-family;
       description
         "AS Number Family -
          IANA Registry Assigned Number: 18";
     }

     identity xtp-v4 {
       base address-family;
       description
         "Xpress Transport Protocol (XTP) over IPv4
          Address Family - IANA Registry Assigned Number: 19";
     }

     identity xtp-v6 {
       base address-family;
       description
         "Xpress Transport Protocol (XTP) over IPv4
          Address Family - IANA Registry Assigned Number: 20";
     }

     identity xtp-native {
       base address-family;
       description
         "Xpress Transport Protocol (XTP) native mode
          Address Family - IANA Registry Assigned Number: 21";
     }

     identity fc-port {
       base address-family;
       description
         "Fibre Channel (FC) World-Wide Port Name
          Address Family - IANA Registry Assigned Number: 22";
     }

     identity fc-node {
       base address-family;
       description
         "Fibre Channel (FC) World-Wide Node Name
          Address Family - IANA Registry Assigned Number: 23";
     }
```

```
     identity gwid {
       base address-family;
       description
         "ATM Gateway Identifier (GWID) Number Family -
          IANA Registry Assigned Number: 24";
     }

     identity l2vpn {
       base address-family;
       description
         "Layer-2 VPN (L2VPN) Address Family -
          IANA Registry Assigned Number: 25";
     }

     identity mpls-tp-section-eid {
       base address-family;
       description
         "MPLS-TP Section Endpoint Identifier Address Family -
          IANA Registry Assigned Number: 26";
     }

     identity mpls-tp-lsp-eid {
       base address-family;
       description
         "MPLS-TP LSP Endpoint Identifier Address Family -
          IANA Registry Assigned Number: 27";
     }

     identity mpls-tp-pwe-eid {
       base address-family;
       description
         "MPLS-TP Pseudowire Endpoint Identifier
          Address Family - IANA Registry Assigned Number: 28";
     }

     identity mt-v4 {
       base address-family;
       description
         "Multi-Topology IPv4 Address Family -
          Address Family - IANA Registry Assigned Number: 29";
     }

     identity mt-v6 {
       base address-family;
       description
         "Multi-Topology IPv6 Address Family -
          Address Family - IANA Registry Assigned Number: 30";
     }
```

```
     identity eigrp-common-sf {
       base address-family;
       description
         "Enhanced Interior Gateway Routing Protocol (EIGRP)
          Common Service Family Address Family -
          IANA Registry Assigned Number: 16384";
     }

     identity eigrp-v4-sf {
       base address-family;
       description
         "Enhanced Interior Gateway Routing Protocol (EIGRP)
          IPv4 Service Family Address Family -
          IANA Registry Assigned Number: 16385";
     }

     identity eigrp-v6-sf {
       base address-family;
       description
         "Enhanced Interior Gateway Routing Protocol (EIGRP)
          IPv6 Service Family Address Family -
          IANA Registry Assigned Number: 16386";
     }

     identity lcaf {
       base address-family;
       description
         "LISP Canonical Address Format (LCAF)
          Address Family - IANA Registry Assigned Number: 16387";
     }

     identity bgp-ls {
       base address-family;
       description
         "Border Gatway Protocol - Link State (BGP-LS)
          Address Family - IANA Registry Assigned Number: 16388";
     }

     identity mac-48 {
       base address-family;
       description
         "IEEE 48-bit Media Access Control (MAC)
          Address Family - IANA Registry Assigned Number: 16389";
     }

     identity mac-64 {
       base address-family;
       description
```

```
        "IEEE 64-bit Media Access Control (MAC)
         Address Family - IANA Registry Assigned Number: 16390";
    }

    identity trill-oui {
      base address-family;
      description
        "TRILL IEEE Organizationally Unique Identifier (OUI) -
         Address Family - IANA Registry Assigned Number: 16391";
    }

    identity trill-mac-24 {
      base address-family;
      description
        "TRILL Final 3 octets of 48-bit MAC address
         Address Family - IANA Registry Assigned Number: 16392";
    }

    identity trill-mac-48 {
      base address-family;
      description
        "TRILL Final 5 octets of 64-bit MAC address
         Address Family - IANA Registry Assigned Number: 16393";
    }

    identity trill-rbridge-port-id {
      base address-family;
      description
        "TRILL Remote Bridge (RBridge) Port ID
         Address Family - IANA Registry Assigned Number: 16394";
    }

    identity trill-nickname {
      base address-family;
      description
        "TRILL Nickname
         Address Family - IANA Registry Assigned Number: 16395";
    }

    /*** SAFIs for Multi-Protocol BGP Identities ***/

    identity bgp-safi {
      description
        "Base identity from which identities describing BGP
         Subsequent Address Family Identifier (SAFI) - RFC 4760.";
    }

    identity unicast-safi {
```

```
      base bgp-safi;
      description
        "Unicast SAFI -
         IANA Registry Assigned Number: 1";
    }

    identity multicast-safi {
      base bgp-safi;
      description
        "Multicast SAFI -
         IANA Registry Assigned Number: 2";
    }

    identity labeled-unicast-safi {
      base bgp-safi;
      description
        "Labeled Unicast SAFI -
         IANA Registry Assigned Number: 4";
    }

    identity multicast-vpn-safi {
      base bgp-safi;
      description
        "Multicast VPN SAFI -
         IANA Registry Assigned Number: 5";
    }

    identity pseudowire-safi {
      base bgp-safi;
      description
        "Multi-segment Pseudowire VPN SAFI -
         IANA Registry Assigned Number: 6";
    }

    identity tunnel-enap-safi {
      base bgp-safi;
      description
        "Tunnel Encap SAFI -
         IANA Registry Assigned Number: 7";
    }

    identity mcast-vpls-safi {
      base bgp-safi;
      description
        "Multicast Virtual Private LAN Service (VPLS) SAFI -
         IANA Registry Assigned Number: 8";
    }
```

```
     identity tunnel-safi {
       base bgp-safi;
       description
         "Tunnel SAFI -
          IANA Registry Assigned Number: 64";
     }

     identity vpls-safi {
       base bgp-safi;
       description
         "Virtual Private LAN Service (VPLS) SAFI -
          IANA Registry Assigned Number: 65";
     }

     identity mdt-safi {
       base bgp-safi;
       description
         "Multicast Distribution Tree (MDT) SAFI -
          IANA Registry Assigned Number: 66";
     }

     identity v4-over-v6-safi {
       base bgp-safi;
       description
         "IPv4 over IPv6 SAFI -
          IANA Registry Assigned Number: 67";
     }

     identity v6-over-v4-safi {
       base bgp-safi;
       description
         "IPv6 over IPv4 SAFI -
          IANA Registry Assigned Number: 68";
     }

     identity l1-vpn-auto-discovery-safi {
       base bgp-safi;
       description
         "Layer-1 VPN Auto Discovery SAFI -
          IANA Registry Assigned Number: 69";
     }

     identity evpn-safi {
       base bgp-safi;
       description
         "Ethernet VPN (EVPN) SAFI -
          IANA Registry Assigned Number: 70";
     }
```

```
     identity bgp-ls-safi {
       base bgp-safi;
       description
         "BGP Link-State (BGP-LS) SAFI -
          IANA Registry Assigned Number: 71";
     }

     identity bgp-ls-vpn-safi {
       base bgp-safi;
       description
         "BGP Link-State (BGP-LS) VPN SAFI -
          IANA Registry Assigned Number: 72";
     }

     identity sr-te-safi {
       base bgp-safi;
       description
         "Segment Routing - Traffic Engineering (SR-TE) SAFI -
          IANA Registry Assigned Number: 73";
     }

     identity labeled-vpn-safi {
       base bgp-safi;
       description
         "MPLS Labeled VPN SAFI -
          IANA Registry Assigned Number: 128";
     }

     identity multicast-mpls-vpn-safi {
       base bgp-safi;
       description
         "Multicast for BGP/MPLS IP VPN SAFI -
          IANA Registry Assigned Number: 129";
     }

     identity route-target-safi {
       base bgp-safi;
       description
         "Route Target SAFI -
          IANA Registry Assigned Number: 132";
     }

     identity ipv4-flow-spec-safi {
       base bgp-safi;
       description
         "IPv4 Flow Specification SAFI -
          IANA Registry Assigned Number: 133";
     }
```

```
    identity vpnv4-flow-spec-safi {
      base bgp-safi;
      description
        "IPv4 VPN Flow Specification SAFI -
         IANA Registry Assigned Number: 134";
    }
  }
```

<CODE ENDS>

5. IANA Considerations

RFC Ed.: In this section, replace all occurrences of 'XXXX' with the actual RFC number (and remove this note).

This document registers the following namespace URIs in the IETF XML registry [RFC3688]:

```
---------------------------------------------------------------------
URI: urn:ietf:params:xml:ns:yang:ietf-routing-types
Registrant Contact: The IESG.
XML: N/A, the requested URI is an XML namespace.
---------------------------------------------------------------------

---------------------------------------------------------------------
URI: urn:ietf:params:xml:ns:yang:iana-routing-types
Registrant Contact: IANA
XML: N/A, the requested URI is an XML namespace.
---------------------------------------------------------------------
```

This document registers the following YANG modules in the YANG Module Names registry [RFC6020]:

```
---------------------------------------------------------------------
name:         ietf-routing-types
namespace:    urn:ietf:params:xml:ns:yang:ietf-routing-types
prefix:       rt-types
reference:    RFC XXXX
---------------------------------------------------------------------

---------------------------------------------------------------------
name:         iana-routing-types
namespace:    urn:ietf:params:xml:ns:yang:iana-routing-types
prefix:       iana-rt-types
reference:    RFC XXXX
---------------------------------------------------------------------
```

5.1. IANA-Maintained iana-routing-types Module

This document defines the initial version of the IANA-maintained iana-routing-types YANG module.

The iana-routing-types YANG module is intended to reflect the "Address Family Numbers" registry [IANA-ADDRESS-FAMILY-REGISTRY] and "Subsequent Address Family Identifiers (SAFI) Parameters" registry [IANA-SAFI-REGISTRY].

IANA has added this notes to the "iana-routing-types YANG Module" registry:

> Address Families and Subsequent Address Families must not be directly added to the iana-routing-types YANG module. They must instead be respectively added to the "Address Family Numbers" and "Subsequent Address Family Identifiers (SAFI) Parameters" registries.

When an Address Family or Subsequent Address Family is respectively added to the "Address Family Numbers" registry or the "Subsequent Address Family Identifiers (SAFI) Parameters" registry, a new "identity" statement must be added to the iana-routing-types YANG module. The name of the "identity" is the same as the corresponding address family or SAFI only it willl be a valid YANG identifier in all lowercase and with hyphens separating individual words in compound identifiers. The following substatements to the "identity" statement should be defined:

"base": Contains the value "address-family" for address families or "bgp-safi" for subsequent address families.

"status": Include only if a registration has been deprecated (use the value "deprecated") or obsoleted (use the value "obsolete").

"description": Replicate the description from the registry, if any. Insert line breaks as needed so that the line does not exceed 72 characters.

"reference": Replicate the reference from the registry, if any, and add the title of the document.

Unassigned or reserved values are not present in these modules.

When the iana-routing-types YANG module is updated, a new "revision" statement must be added in front of the existing revision statements.

IANA has added this new note to the the "Address Family Numbers" and "Subsequent Address Family Identifiers (SAFI) Parameters" registries:

> When this registry is modified, the YANG module iana-routing-types must be updated as defined in RFC XXXX.

6. Security Considerations

This document defines common data types using the YANG data modeling language. The definitions themselves have no security impact on the Internet, but the usage of these definitions in concrete YANG modules might have. The security considerations spelled out in the YANG specification [RFC7950] apply for this document as well.

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