Internet Engineering Task Force (IETF)
Request for Comments: 6991
Obsoletes: 6021
Category: Standards Track
ISSN: 2070-1721

J. Schoenwaelder, Ed.
Jacobs University

July 2013

Common YANG Data Types

Abstract

This document introduces a collection of common data types to be used with the YANG data modeling language. This document obsoletes RFC 6021.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc6991.

Copyright Notice

Copyright (c) 2013 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (http://trustee.ietf.org/license-info) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

This document may contain material from IETF Documents or IETF Contributions published or made publicly available before November 10, 2008. The person(s) controlling the copyright in some of this material may not have granted the IETF Trust the right to allow

modifications of such material outside the IETF Standards Process. Without obtaining an adequate license from the person(s) controlling the copyright in such materials, this document may not be modified outside the IETF Standards Process, and derivative works of it may not be created outside the IETF Standards Process, except to format it for publication as an RFC or to translate it into languages other than English.

Table of Contents

1. Introduction

YANG [RFC6020] is a data modeling language used to model configuration and state data manipulated by the Network Configuration Protocol (NETCONF) [RFC6241]. 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 applicable for modeling all areas of management information. The definitions are organized in several YANG modules. The "ietf-yang-types" module contains generally useful data types. The "ietf-inet-types" module contains definitions that are relevant for the Internet protocol suite.

This document adds new type definitions to the YANG modules and obsoletes [RFC6021]. For further details, see the revision statements of the YANG modules in Sections 3 and 4 or the summary in Appendix A.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119].

2. Overview

This section provides a short overview of the types defined in subsequent sections and their equivalent Structure of Management Information Version 2 (SMIv2) [RFC2578][RFC2579] data types. A YANG data type is equivalent to an SMIv2 data type if the data types have the same set of values and the semantics of the values are equivalent.

Table 1 lists the types defined in the ietf-yang-types YANG module and the corresponding SMIv2 types (- indicates there is no corresponding SMIv2 type).

YANG type	Equivalent SMIv2 type (module)
counter32	Counter32 (SNMPv2-SMI)
zero-based-counter32	ZeroBasedCounter32 (RMON2-MIB)
counter64	Counter64 (SNMPv2-SMI)
zero-based-counter64	ZeroBasedCounter64 (HCNUM-TC)
gauge32	Gauge32 (SNMPv2-SMI)
gauge64	CounterBasedGauge64 (HCNUM-TC)
object-identifier	-
object-identifier-128	OBJECT IDENTIFIER
yang-identifier	-
date-and-time	-
timeticks	TimeTicks (SNMPv2-SMI)
timestamp	TimeStamp (SNMPv2-TC)
phys-address	PhysAddress (SNMPv2-TC)
mac-address	MacAddress (SNMPv2-TC)
xpath1.0	-
hex-string	-
uuid	-
dotted-quad	-

Table 1: ietf-yang-types

Table 2 lists the types defined in the ietf-inet-types YANG module and the corresponding SMIv2 types (if any).

YANG type	Equivalent SMIv2 type (module)
ip-version	InetVersion (INET-ADDRESS-MIB)
dscp	Dscp (DIFFSERV-DSCP-TC)
ipv6-flow-label	IPv6FlowLabel (IPV6-FLOW-LABEL-MIB)
port-number	InetPortNumber (INET-ADDRESS-MIB)
as-number	InetAutonomousSystemNumber (INET-ADDRESS-MIB)
ip-address	-
ipv4-address	-
ipv6-address	-
ip-address-no-zone	-
ipv4-address-no-zone	-
ipv6-address-no-zone	-
ip-prefix	-
ipv4-prefix	-
ipv6-prefix	-
domain-name	-
host	-
uri	Uri (URI-TC-MIB)

Table 2: ietf-inet-types

3. Core YANG Derived Types

The ietf-yang-types YANG module references [IEEE802], [ISO9834-1], [RFC2578], [RFC2579], [RFC2856], [RFC3339], [RFC4122], [RFC4502], [RFC6020], [XPATH], and [XSD-TYPES].

<CODE BEGINS> file "ietf-yang-types@2013-07-15.yang"

```
module ietf-yang-types {

  namespace "urn:ietf:params:xml:ns:yang:ietf-yang-types";
  prefix "yang";

  organization
   "IETF NETMOD (NETCONF Data Modeling Language) Working Group";

  contact
   "WG Web:   <http://tools.ietf.org/wg/netmod/>
    WG List:  <mailto:netmod@ietf.org>
```

```
       WG Chair: David Kessens
                 <mailto:david.kessens@nsn.com>

       WG Chair: Juergen Schoenwaelder
                 <mailto:j.schoenwaelder@jacobs-university.de>

       Editor:   Juergen Schoenwaelder
                 <mailto:j.schoenwaelder@jacobs-university.de>";

     description
      "This module contains a collection of generally useful derived
       YANG data types.

       Copyright (c) 2013 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 6991; see
       the RFC itself for full legal notices.";

     revision 2013-07-15 {
       description
        "This revision adds the following new data types:
         - yang-identifier
         - hex-string
         - uuid
         - dotted-quad";
       reference
        "RFC 6991: Common YANG Data Types";
     }

     revision 2010-09-24 {
       description
        "Initial revision.";
       reference
        "RFC 6021: Common YANG Data Types";
     }

     /*** collection of counter and gauge types ***/

     typedef counter32 {
       type uint32;
```

```
      description
       "The counter32 type represents a non-negative integer
        that monotonically increases until it reaches a
        maximum value of 2^32-1 (4294967295 decimal), when it
        wraps around and starts increasing again from zero.

        Counters have no defined 'initial' value, and thus, a
        single value of a counter has (in general) no information
        content.  Discontinuities in the monotonically increasing
        value normally occur at re-initialization of the
        management system, and at other times as specified in the
        description of a schema node using this type.  If such
        other times can occur, for example, the creation of
        a schema node of type counter32 at times other than
        re-initialization, then a corresponding schema node
        should be defined, with an appropriate type, to indicate
        the last discontinuity.

        The counter32 type should not be used for configuration
        schema nodes.  A default statement SHOULD NOT be used in
        combination with the type counter32.

        In the value set and its semantics, this type is equivalent
        to the Counter32 type of the SMIv2.";
      reference
       "RFC 2578: Structure of Management Information Version 2
                  (SMIv2)";
    }

    typedef zero-based-counter32 {
      type yang:counter32;
      default "0";
      description
       "The zero-based-counter32 type represents a counter32
        that has the defined 'initial' value zero.

        A schema node of this type will be set to zero (0) on creation
        and will thereafter increase monotonically until it reaches
        a maximum value of 2^32-1 (4294967295 decimal), when it
        wraps around and starts increasing again from zero.

        Provided that an application discovers a new schema node
        of this type within the minimum time to wrap, it can use the
        'initial' value as a delta.  It is important for a management
        station to be aware of this minimum time and the actual time
        between polls, and to discard data if the actual time is too
        long or there is no defined minimum time.
```

```
        In the value set and its semantics, this type is equivalent
        to the ZeroBasedCounter32 textual convention of the SMIv2.";
      reference
        "RFC 4502: Remote Network Monitoring Management Information
                   Base Version 2";
    }

    typedef counter64 {
      type uint64;
      description
       "The counter64 type represents a non-negative integer
        that monotonically increases until it reaches a
        maximum value of 2^64-1 (18446744073709551615 decimal),
        when it wraps around and starts increasing again from zero.

        Counters have no defined 'initial' value, and thus, a
        single value of a counter has (in general) no information
        content.  Discontinuities in the monotonically increasing
        value normally occur at re-initialization of the
        management system, and at other times as specified in the
        description of a schema node using this type.  If such
        other times can occur, for example, the creation of
        a schema node of type counter64 at times other than
        re-initialization, then a corresponding schema node
        should be defined, with an appropriate type, to indicate
        the last discontinuity.

        The counter64 type should not be used for configuration
        schema nodes.  A default statement SHOULD NOT be used in
        combination with the type counter64.

        In the value set and its semantics, this type is equivalent
        to the Counter64 type of the SMIv2.";
      reference
       "RFC 2578: Structure of Management Information Version 2
                  (SMIv2)";
    }

    typedef zero-based-counter64 {
      type yang:counter64;
      default "0";
      description
       "The zero-based-counter64 type represents a counter64 that
        has the defined 'initial' value zero.
```

```
        A schema node of this type will be set to zero (0) on creation
        and will thereafter increase monotonically until it reaches
        a maximum value of 2^64-1 (18446744073709551615 decimal),
        when it wraps around and starts increasing again from zero.

        Provided that an application discovers a new schema node
        of this type within the minimum time to wrap, it can use the
        'initial' value as a delta.  It is important for a management
        station to be aware of this minimum time and the actual time
        between polls, and to discard data if the actual time is too
        long or there is no defined minimum time.

        In the value set and its semantics, this type is equivalent
        to the ZeroBasedCounter64 textual convention of the SMIv2.";
      reference
       "RFC 2856: Textual Conventions for Additional High Capacity
                  Data Types";
    }

    typedef gauge32 {
      type uint32;
      description
       "The gauge32 type represents a non-negative integer, which
        may increase or decrease, but shall never exceed a maximum
        value, nor fall below a minimum value.  The maximum value
        cannot be greater than 2^32-1 (4294967295 decimal), and
        the minimum value cannot be smaller than 0.  The value of
        a gauge32 has its maximum value whenever the information
        being modeled is greater than or equal to its maximum
        value, and has its minimum value whenever the information
        being modeled is smaller than or equal to its minimum value.
        If the information being modeled subsequently decreases
        below (increases above) the maximum (minimum) value, the
        gauge32 also decreases (increases).

        In the value set and its semantics, this type is equivalent
        to the Gauge32 type of the SMIv2.";
      reference
       "RFC 2578: Structure of Management Information Version 2
                  (SMIv2)";
    }

    typedef gauge64 {
      type uint64;
      description
       "The gauge64 type represents a non-negative integer, which
        may increase or decrease, but shall never exceed a maximum
        value, nor fall below a minimum value.  The maximum value
```

```
      cannot be greater than 2^64-1 (18446744073709551615), and
      the minimum value cannot be smaller than 0.  The value of
      a gauge64 has its maximum value whenever the information
      being modeled is greater than or equal to its maximum
      value, and has its minimum value whenever the information
      being modeled is smaller than or equal to its minimum value.
      If the information being modeled subsequently decreases
      below (increases above) the maximum (minimum) value, the
      gauge64 also decreases (increases).

      In the value set and its semantics, this type is equivalent
      to the CounterBasedGauge64 SMIv2 textual convention defined
      in RFC 2856";
    reference
     "RFC 2856: Textual Conventions for Additional High Capacity
                Data Types";
  }

  /*** collection of identifier-related types ***/

  typedef object-identifier {
    type string {
      pattern '(([0-1](\.[1-3]?[0-9]))|(2\.(0|([1-9]\d*))))'
            + '(\.(0|([1-9]\d*)))*';
    }
    description
     "The object-identifier type represents administratively
      assigned names in a registration-hierarchical-name tree.

      Values of this type are denoted as a sequence of numerical
      non-negative sub-identifier values.  Each sub-identifier
      value MUST NOT exceed 2^32-1 (4294967295).  Sub-identifiers
      are separated by single dots and without any intermediate
      whitespace.

      The ASN.1 standard restricts the value space of the first
      sub-identifier to 0, 1, or 2.  Furthermore, the value space
      of the second sub-identifier is restricted to the range
      0 to 39 if the first sub-identifier is 0 or 1.  Finally,
      the ASN.1 standard requires that an object identifier
      has always at least two sub-identifiers.  The pattern
      captures these restrictions.

      Although the number of sub-identifiers is not limited,
      module designers should realize that there may be
      implementations that stick with the SMIv2 limit of 128
      sub-identifiers.
```

```
      This type is a superset of the SMIv2 OBJECT IDENTIFIER type
      since it is not restricted to 128 sub-identifiers.  Hence,
      this type SHOULD NOT be used to represent the SMIv2 OBJECT
      IDENTIFIER type; the object-identifier-128 type SHOULD be
      used instead.";
    reference
     "ISO9834-1: Information technology -- Open Systems
      Interconnection -- Procedures for the operation of OSI
      Registration Authorities: General procedures and top
      arcs of the ASN.1 Object Identifier tree";
  }

  typedef object-identifier-128 {
    type object-identifier {
      pattern '\d*(\.\d*){1,127}';
    }
    description
     "This type represents object-identifiers restricted to 128
      sub-identifiers.

      In the value set and its semantics, this type is equivalent
      to the OBJECT IDENTIFIER type of the SMIv2.";
    reference
     "RFC 2578: Structure of Management Information Version 2
                (SMIv2)";
  }

  typedef yang-identifier {
    type string {
      length "1..max";
      pattern '[a-zA-Z_][a-zA-Z0-9\-_.]*';
      pattern '.|..|[^xX].*|.[^mM].*|..[^lL].*';
    }
    description
      "A YANG identifier string as defined by the 'identifier'
       rule in Section 12 of RFC 6020.  An identifier must
       start with an alphabetic character or an underscore
       followed by an arbitrary sequence of alphabetic or
       numeric characters, underscores, hyphens, or dots.

       A YANG identifier MUST NOT start with any possible
       combination of the lowercase or uppercase character
       sequence 'xml'.";
    reference
      "RFC 6020: YANG - A Data Modeling Language for the Network
                 Configuration Protocol (NETCONF)";
  }
```

```
/*** collection of types related to date and time***/

typedef date-and-time {
  type string {
    pattern '\d{4}-\d{2}-\d{2}T\d{2}:\d{2}:\d{2}(\.\d+)?'
          + '(Z|[\+\-]\d{2}:\d{2})';
  }
  description
   "The date-and-time type is a profile of the ISO 8601
    standard for representation of dates and times using the
    Gregorian calendar.  The profile is defined by the
    date-time production in Section 5.6 of RFC 3339.

    The date-and-time type is compatible with the dateTime XML
    schema type with the following notable exceptions:

    (a) The date-and-time type does not allow negative years.

    (b) The date-and-time time-offset -00:00 indicates an unknown
        time zone (see RFC 3339) while -00:00 and +00:00 and Z
        all represent the same time zone in dateTime.

    (c) The canonical format (see below) of data-and-time values
        differs from the canonical format used by the dateTime XML
        schema type, which requires all times to be in UTC using
        the time-offset 'Z'.

    This type is not equivalent to the DateAndTime textual
    convention of the SMIv2 since RFC 3339 uses a different
    separator between full-date and full-time and provides
    higher resolution of time-secfrac.

    The canonical format for date-and-time values with a known time
    zone uses a numeric time zone offset that is calculated using
    the device's configured known offset to UTC time.  A change of
    the device's offset to UTC time will cause date-and-time values
    to change accordingly.  Such changes might happen periodically
    in case a server follows automatically daylight saving time
    (DST) time zone offset changes.  The canonical format for
    date-and-time values with an unknown time zone (usually
    referring to the notion of local time) uses the time-offset
    -00:00.";
  reference
   "RFC 3339: Date and Time on the Internet: Timestamps
    RFC 2579: Textual Conventions for SMIv2
    XSD-TYPES: XML Schema Part 2: Datatypes Second Edition";
}
```

```
typedef timeticks {
  type uint32;
  description
   "The timeticks type represents a non-negative integer that
    represents the time, modulo 2^32 (4294967296 decimal), in
    hundredths of a second between two epochs.  When a schema
    node is defined that uses this type, the description of
    the schema node identifies both of the reference epochs.

    In the value set and its semantics, this type is equivalent
    to the TimeTicks type of the SMIv2.";
  reference
   "RFC 2578: Structure of Management Information Version 2
              (SMIv2)";
}

typedef timestamp {
  type yang:timeticks;
  description
   "The timestamp type represents the value of an associated
    timeticks schema node at which a specific occurrence
    happened.  The specific occurrence must be defined in the
    description of any schema node defined using this type.  When
    the specific occurrence occurred prior to the last time the
    associated timeticks attribute was zero, then the timestamp
    value is zero.  Note that this requires all timestamp values
    to be reset to zero when the value of the associated timeticks
    attribute reaches 497+ days and wraps around to zero.

    The associated timeticks schema node must be specified
    in the description of any schema node using this type.

    In the value set and its semantics, this type is equivalent
    to the TimeStamp textual convention of the SMIv2.";
  reference
   "RFC 2579: Textual Conventions for SMIv2";
}

/*** collection of generic address types ***/

typedef phys-address {
  type string {
    pattern '([0-9a-fA-F]{2}(:[0-9a-fA-F]{2})*)?';
  }
```

```
      description
       "Represents media- or physical-level addresses represented
        as a sequence octets, each octet represented by two hexadecimal
        numbers.  Octets are separated by colons.  The canonical
        representation uses lowercase characters.

        In the value set and its semantics, this type is equivalent
        to the PhysAddress textual convention of the SMIv2.";
      reference
       "RFC 2579: Textual Conventions for SMIv2";
    }

    typedef mac-address {
      type string {
        pattern '[0-9a-fA-F]{2}(:[0-9a-fA-F]{2}){5}';
      }
      description
       "The mac-address type represents an IEEE 802 MAC address.
        The canonical representation uses lowercase characters.

        In the value set and its semantics, this type is equivalent
        to the MacAddress textual convention of the SMIv2.";
      reference
       "IEEE 802: IEEE Standard for Local and Metropolitan Area
                  Networks: Overview and Architecture
        RFC 2579: Textual Conventions for SMIv2";
    }

    /*** collection of XML-specific types ***/

    typedef xpath1.0 {
      type string;
      description
       "This type represents an XPATH 1.0 expression.

        When a schema node is defined that uses this type, the
        description of the schema node MUST specify the XPath
        context in which the XPath expression is evaluated.";
      reference
       "XPATH: XML Path Language (XPath) Version 1.0";
    }

    /*** collection of string types ***/

    typedef hex-string {
      type string {
        pattern '([0-9a-fA-F]{2}(:[0-9a-fA-F]{2})*)?';
      }
```

```
      description
       "A hexadecimal string with octets represented as hex digits
        separated by colons.  The canonical representation uses
        lowercase characters.";
    }

    typedef uuid {
      type string {
        pattern '[0-9a-fA-F]{8}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-'
              + '[0-9a-fA-F]{4}-[0-9a-fA-F]{12}';
      }
      description
       "A Universally Unique IDentifier in the string representation
        defined in RFC 4122.  The canonical representation uses
        lowercase characters.

        The following is an example of a UUID in string representation:
        f81d4fae-7dec-11d0-a765-00a0c91e6bf6
        ";
      reference
       "RFC 4122: A Universally Unique IDentifier (UUID) URN
                  Namespace";
    }

    typedef dotted-quad {
      type string {
        pattern
          '(([0-9]|[1-9][0-9]|1[0-9][0-9]|2[0-4][0-9]|25[0-5])\.){3}'
        + '([0-9]|[1-9][0-9]|1[0-9][0-9]|2[0-4][0-9]|25[0-5])';
      }
      description
        "An unsigned 32-bit number expressed in the dotted-quad
         notation, i.e., four octets written as decimal numbers
         and separated with the '.' (full stop) character.";
    }
  }

  <CODE ENDS>
```

4. Internet-Specific Derived Types

The ietf-inet-types YANG module references [RFC0768], [RFC0791], [RFC0793], [RFC0952], [RFC1034], [RFC1123], [RFC1930], [RFC2460], [RFC2474], [RFC2780], [RFC2782], [RFC3289], [RFC3305], [RFC3595], [RFC3986], [RFC4001], [RFC4007], [RFC4271], [RFC4291], [RFC4340], [RFC4960], [RFC5017], [RFC5890], [RFC5952], and [RFC6793].

```
<CODE BEGINS> file "ietf-inet-types@2013-07-15.yang"

module ietf-inet-types {

  namespace "urn:ietf:params:xml:ns:yang:ietf-inet-types";
  prefix "inet";

  organization
   "IETF NETMOD (NETCONF Data Modeling Language) Working Group";

  contact
   "WG Web:   <http://tools.ietf.org/wg/netmod/>
    WG List:  <mailto:netmod@ietf.org>

    WG Chair: David Kessens
              <mailto:david.kessens@nsn.com>

    WG Chair: Juergen Schoenwaelder
              <mailto:j.schoenwaelder@jacobs-university.de>

    Editor:   Juergen Schoenwaelder
              <mailto:j.schoenwaelder@jacobs-university.de>";

  description
   "This module contains a collection of generally useful derived
    YANG data types for Internet addresses and related things.

    Copyright (c) 2013 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 6991; see
    the RFC itself for full legal notices.";

  revision 2013-07-15 {
    description
     "This revision adds the following new data types:
      - ip-address-no-zone
      - ipv4-address-no-zone
      - ipv6-address-no-zone";
    reference
     "RFC 6991: Common YANG Data Types";
```

```
  }

  revision 2010-09-24 {
    description
     "Initial revision.";
    reference
     "RFC 6021: Common YANG Data Types";
  }

  /*** collection of types related to protocol fields ***/

  typedef ip-version {
    type enumeration {
      enum unknown {
        value "0";
        description
         "An unknown or unspecified version of the Internet
          protocol.";
      }
      enum ipv4 {
        value "1";
        description
         "The IPv4 protocol as defined in RFC 791.";
      }
      enum ipv6 {
        value "2";
        description
         "The IPv6 protocol as defined in RFC 2460.";
      }
    }
    description
     "This value represents the version of the IP protocol.

      In the value set and its semantics, this type is equivalent
      to the InetVersion textual convention of the SMIv2.";
    reference
     "RFC  791: Internet Protocol
      RFC 2460: Internet Protocol, Version 6 (IPv6) Specification
      RFC 4001: Textual Conventions for Internet Network Addresses";
  }

  typedef dscp {
    type uint8 {
      range "0..63";
    }
    description
     "The dscp type represents a Differentiated Services Code Point
      that may be used for marking packets in a traffic stream.
```

```
        In the value set and its semantics, this type is equivalent
        to the Dscp textual convention of the SMIv2.";
      reference
       "RFC 3289: Management Information Base for the Differentiated
                  Services Architecture
        RFC 2474: Definition of the Differentiated Services Field
                  (DS Field) in the IPv4 and IPv6 Headers
        RFC 2780: IANA Allocation Guidelines For Values In
                  the Internet Protocol and Related Headers";
    }

    typedef ipv6-flow-label {
      type uint32 {
        range "0..1048575";
      }
      description
       "The ipv6-flow-label type represents the flow identifier or Flow
        Label in an IPv6 packet header that may be used to
        discriminate traffic flows.

        In the value set and its semantics, this type is equivalent
        to the IPv6FlowLabel textual convention of the SMIv2.";
      reference
       "RFC 3595: Textual Conventions for IPv6 Flow Label
        RFC 2460: Internet Protocol, Version 6 (IPv6) Specification";
    }

    typedef port-number {
      type uint16 {
        range "0..65535";
      }
      description
       "The port-number type represents a 16-bit port number of an
        Internet transport-layer protocol such as UDP, TCP, DCCP, or
        SCTP.  Port numbers are assigned by IANA.  A current list of
        all assignments is available from <http://www.iana.org/>.

        Note that the port number value zero is reserved by IANA.  In
        situations where the value zero does not make sense, it can
        be excluded by subtyping the port-number type.
        In the value set and its semantics, this type is equivalent
        to the InetPortNumber textual convention of the SMIv2.";
      reference
       "RFC  768: User Datagram Protocol
        RFC  793: Transmission Control Protocol
        RFC 4960: Stream Control Transmission Protocol
        RFC 4340: Datagram Congestion Control Protocol (DCCP)
        RFC 4001: Textual Conventions for Internet Network Addresses";
```

```
}

/*** collection of types related to autonomous systems ***/

typedef as-number {
  type uint32;
  description
   "The as-number type represents autonomous system numbers
    which identify an Autonomous System (AS).  An AS is a set
    of routers under a single technical administration, using
    an interior gateway protocol and common metrics to route
    packets within the AS, and using an exterior gateway
    protocol to route packets to other ASes.  IANA maintains
    the AS number space and has delegated large parts to the
    regional registries.

    Autonomous system numbers were originally limited to 16
    bits.  BGP extensions have enlarged the autonomous system
    number space to 32 bits.  This type therefore uses an uint32
    base type without a range restriction in order to support
    a larger autonomous system number space.

    In the value set and its semantics, this type is equivalent
    to the InetAutonomousSystemNumber textual convention of
    the SMIv2.";
  reference
   "RFC 1930: Guidelines for creation, selection, and registration
              of an Autonomous System (AS)
    RFC 4271: A Border Gateway Protocol 4 (BGP-4)
    RFC 4001: Textual Conventions for Internet Network Addresses
    RFC 6793: BGP Support for Four-Octet Autonomous System (AS)
              Number Space";
}

/*** collection of types related to IP addresses and hostnames ***/

typedef ip-address {
  type union {
    type inet:ipv4-address;
    type inet:ipv6-address;
  }
  description
   "The ip-address type represents an IP address and is IP
    version neutral.  The format of the textual representation
    implies the IP version.  This type supports scoped addresses
    by allowing zone identifiers in the address format.";
  reference
   "RFC 4007: IPv6 Scoped Address Architecture";
```

```
}

typedef ipv4-address {
  type string {
    pattern
      '(([0-9]|[1-9][0-9]|1[0-9][0-9]|2[0-4][0-9]|25[0-5])\.){3}'
    +  '([0-9]|[1-9][0-9]|1[0-9][0-9]|2[0-4][0-9]|25[0-5])'
    + '(%[\p{N}\p{L}]+)?';
  }
  description
    "The ipv4-address type represents an IPv4 address in
     dotted-quad notation.  The IPv4 address may include a zone
     index, separated by a % sign.

     The zone index is used to disambiguate identical address
     values.  For link-local addresses, the zone index will
     typically be the interface index number or the name of an
     interface.  If the zone index is not present, the default
     zone of the device will be used.

     The canonical format for the zone index is the numerical
     format";
}

typedef ipv6-address {
  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])))'
          + '(%[\p{N}\p{L}]+)?';
    pattern '(([^:]+:){6}(([^:]+:[^:]+)|(.*\..*)))|'
          + '((([^:]+:)*[^:]+)?::(([^:]+:)*[^:]+)?)'
          + '(%.+)?';
  }
  description
   "The ipv6-address type represents an IPv6 address in full,
    mixed, shortened, and shortened-mixed notation.  The IPv6
    address may include a zone index, separated by a % sign.

    The zone index is used to disambiguate identical address
    values.  For link-local addresses, the zone index will
    typically be the interface index number or the name of an
    interface.  If the zone index is not present, the default
    zone of the device will be used.
```

```
        The canonical format of IPv6 addresses uses the textual
        representation defined in Section 4 of RFC 5952.  The
        canonical format for the zone index is the numerical
        format as described in Section 11.2 of RFC 4007.";
      reference
       "RFC 4291: IP Version 6 Addressing Architecture
        RFC 4007: IPv6 Scoped Address Architecture
        RFC 5952: A Recommendation for IPv6 Address Text
                  Representation";
    }

    typedef ip-address-no-zone {
      type union {
        type inet:ipv4-address-no-zone;
        type inet:ipv6-address-no-zone;
      }
      description
       "The ip-address-no-zone type represents an IP address and is
        IP version neutral.  The format of the textual representation
        implies the IP version.  This type does not support scoped
        addresses since it does not allow zone identifiers in the
        address format.";
      reference
       "RFC 4007: IPv6 Scoped Address Architecture";
    }

    typedef ipv4-address-no-zone {
      type inet:ipv4-address {
        pattern '[0-9\.]*';
      }
      description
        "An IPv4 address without a zone index.  This type, derived from
         ipv4-address, may be used in situations where the zone is
         known from the context and hence no zone index is needed.";
    }

    typedef ipv6-address-no-zone {
      type inet:ipv6-address {
        pattern '[0-9a-fA-F:\.]*';
      }
      description
        "An IPv6 address without a zone index.  This type, derived from
         ipv6-address, may be used in situations where the zone is
         known from the context and hence no zone index is needed.";
      reference
       "RFC 4291: IP Version 6 Addressing Architecture
        RFC 4007: IPv6 Scoped Address Architecture
        RFC 5952: A Recommendation for IPv6 Address Text
```

```
                Representation";
    }

    typedef ip-prefix {
      type union {
        type inet:ipv4-prefix;
        type inet:ipv6-prefix;
      }
      description
       "The ip-prefix type represents an IP prefix and is IP
        version neutral.  The format of the textual representations
        implies the IP version.";
    }

    typedef ipv4-prefix {
      type string {
        pattern
           '(([0-9]|[1-9][0-9]|1[0-9][0-9]|2[0-4][0-9]|25[0-5])\.){3}'
         +  '([0-9]|[1-9][0-9]|1[0-9][0-9]|2[0-4][0-9]|25[0-5])'
         + '/(([0-9])|([1-2][0-9])|(3[0-2]))';
      }
      description
       "The ipv4-prefix type represents an IPv4 address prefix.
        The prefix length is given by the number following the
        slash character and must be less than or equal to 32.

        A prefix length value of n corresponds to an IP address
        mask that has n contiguous 1-bits from the most
        significant bit (MSB) and all other bits set to 0.

        The canonical format of an IPv4 prefix has all bits of
        the IPv4 address set to zero that are not part of the
        IPv4 prefix.";
    }

    typedef ipv6-prefix {
      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])))'
              + '(/(([0-9])|([0-9]{2})|(1[0-1][0-9])|(12[0-8])))';
        pattern '(([^:]+:){6}(([^:]+:[^:]+)|(.*\..*))|'
              + '((([^:]+:)*[^:]+)?::(([^:]+:)*[^:]+)?)'
              + '(/.+)';
      }
```

```
      description
       "The ipv6-prefix type represents an IPv6 address prefix.
        The prefix length is given by the number following the
        slash character and must be less than or equal to 128.

        A prefix length value of n corresponds to an IP address
        mask that has n contiguous 1-bits from the most
        significant bit (MSB) and all other bits set to 0.

        The IPv6 address should have all bits that do not belong
        to the prefix set to zero.

        The canonical format of an IPv6 prefix has all bits of
        the IPv6 address set to zero that are not part of the
        IPv6 prefix.  Furthermore, the IPv6 address is represented
        as defined in Section 4 of RFC 5952.";
      reference
       "RFC 5952: A Recommendation for IPv6 Address Text
                  Representation";
    }

    /*** collection of domain name and URI types ***/

    typedef domain-name {
      type string {
        pattern
          '((([a-zA-Z0-9_]([a-zA-Z0-9\-_]){0,61})?[a-zA-Z0-9]\.)*'
        + '([a-zA-Z0-9_]([a-zA-Z0-9\-_]){0,61})?[a-zA-Z0-9]\.?)'
        + '|\.';
        length "1..253";
      }
      description
       "The domain-name type represents a DNS domain name.  The
        name SHOULD be fully qualified whenever possible.

        Internet domain names are only loosely specified.  Section
        3.5 of RFC 1034 recommends a syntax (modified in Section
        2.1 of RFC 1123).  The pattern above is intended to allow
        for current practice in domain name use, and some possible
        future expansion.  It is designed to hold various types of
        domain names, including names used for A or AAAA records
        (host names) and other records, such as SRV records.  Note
        that Internet host names have a stricter syntax (described
        in RFC 952) than the DNS recommendations in RFCs 1034 and
        1123, and that systems that want to store host names in
        schema nodes using the domain-name type are recommended to
        adhere to this stricter standard to ensure interoperability.
```

```
        The encoding of DNS names in the DNS protocol is limited
        to 255 characters.  Since the encoding consists of labels
        prefixed by a length bytes and there is a trailing NULL
        byte, only 253 characters can appear in the textual dotted
        notation.

        The description clause of schema nodes using the domain-name
        type MUST describe when and how these names are resolved to
        IP addresses.  Note that the resolution of a domain-name value
        may require to query multiple DNS records (e.g., A for IPv4
        and AAAA for IPv6).  The order of the resolution process and
        which DNS record takes precedence can either be defined
        explicitly or may depend on the configuration of the
        resolver.

        Domain-name values use the US-ASCII encoding.  Their canonical
        format uses lowercase US-ASCII characters.  Internationalized
        domain names MUST be A-labels as per RFC 5890.";
      reference
       "RFC  952: DoD Internet Host Table Specification
        RFC 1034: Domain Names - Concepts and Facilities
        RFC 1123: Requirements for Internet Hosts -- Application
                  and Support
        RFC 2782: A DNS RR for specifying the location of services
                  (DNS SRV)
        RFC 5890: Internationalized Domain Names in Applications
                  (IDNA): Definitions and Document Framework";
    }

    typedef host {
      type union {
        type inet:ip-address;
        type inet:domain-name;
      }
      description
       "The host type represents either an IP address or a DNS
        domain name.";
    }

    typedef uri {
      type string;
      description
       "The uri type represents a Uniform Resource Identifier
        (URI) as defined by STD 66.

        Objects using the uri type MUST be in US-ASCII encoding,
        and MUST be normalized as described by RFC 3986 Sections
        6.2.1, 6.2.2.1, and 6.2.2.2.  All unnecessary
```

```
          percent-encoding is removed, and all case-insensitive
          characters are set to lowercase except for hexadecimal
          digits, which are normalized to uppercase as described in
          Section 6.2.2.1.

          The purpose of this normalization is to help provide
          unique URIs.  Note that this normalization is not
          sufficient to provide uniqueness.  Two URIs that are
          textually distinct after this normalization may still be
          equivalent.

          Objects using the uri type may restrict the schemes that
          they permit.  For example, 'data:' and 'urn:' schemes
          might not be appropriate.

          A zero-length URI is not a valid URI.  This can be used to
          express 'URI absent' where required.

          In the value set and its semantics, this type is equivalent
          to the Uri SMIv2 textual convention defined in RFC 5017.";
        reference
         "RFC 3986: Uniform Resource Identifier (URI): Generic Syntax
          RFC 3305: Report from the Joint W3C/IETF URI Planning Interest
                    Group: Uniform Resource Identifiers (URIs), URLs,
                    and Uniform Resource Names (URNs): Clarifications
                    and Recommendations
          RFC 5017: MIB Textual Conventions for Uniform Resource
                    Identifiers (URIs)";
      }

    }

    <CODE ENDS>
```

5. IANA Considerations

This document registers two URIs in the IETF XML registry [RFC3688]. Following the format in RFC 3688, the following registrations have been made.

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

  URI: urn:ietf:params:xml:ns:yang:ietf-inet-types
  Registrant Contact: The NETMOD WG of the IETF.
  XML: N/A, the requested URI is an XML namespace.
```

This document registers two YANG modules in the YANG Module Names registry [RFC6020].

```
name:         ietf-yang-types
namespace:    urn:ietf:params:xml:ns:yang:ietf-yang-types
prefix:       yang
reference:    RFC 6991

name:         ietf-inet-types
namespace:    urn:ietf:params:xml:ns:yang:ietf-inet-types
prefix:       inet
reference:    RFC 6991
```

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 [RFC6020] apply for this document as well.

7. Contributors

The following people contributed significantly to the initial version of this document:

- Andy Bierman (Brocade)
- Martin Bjorklund (Tail-f Systems)
- Balazs Lengyel (Ericsson)
- David Partain (Ericsson)
- Phil Shafer (Juniper Networks)

8. Acknowledgments

The editor wishes to thank the following individuals for providing helpful comments on various versions of this document: Andy Bierman, Martin Bjorklund, Benoit Claise, Joel M. Halpern, Ladislav Lhotka, Lars-Johan Liman, and Dan Romascanu.

Juergen Schoenwaelder was partly funded by Flamingo, a Network of Excellence project (ICT-318488) supported by the European Commission under its Seventh Framework Programme.

9. References

9.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC3339] Klyne, G., Ed. and C. Newman, "Date and Time on the Internet: Timestamps", RFC 3339, July 2002.

[RFC3688] Mealling, M., "The IETF XML Registry", BCP 81, RFC 3688, January 2004.

[RFC3986] Berners-Lee, T., Fielding, R., and L. Masinter, "Uniform Resource Identifier (URI): Generic Syntax", STD 66, RFC 3986, January 2005.

[RFC4007] Deering, S., Haberman, B., Jinmei, T., Nordmark, E., and B. Zill, "IPv6 Scoped Address Architecture", RFC 4007, March 2005.

[RFC4122] Leach, P., Mealling, M., and R. Salz, "A Universally Unique IDentifier (UUID) URN Namespace", RFC 4122, July 2005.

[RFC4291] Hinden, R. and S. Deering, "IP Version 6 Addressing Architecture", RFC 4291, February 2006.

[RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", RFC 6020, October 2010.

[XPATH] Clark, J. and S. DeRose, "XML Path Language (XPath) Version 1.0", World Wide Web Consortium Recommendation REC-xpath-19991116, November 1999, <http://www.w3.org/TR/1999/REC-xpath-19991116>.

9.2. Informative References

[IEEE802] IEEE, "IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture", IEEE Std. 802-2001, 2001.

[ISO9834-1] ISO/IEC, "Information technology -- Open Systems Interconnection -- Procedures for the operation of OSI Registration Authorities: General procedures and top arcs of the ASN.1 Object Identifier tree", ISO/IEC 9834-1:2008, 2008.

[RFC0768] Postel, J., "User Datagram Protocol", STD 6, RFC 768, August 1980.

[RFC0791] Postel, J., "Internet Protocol", STD 5, RFC 791, September 1981.

[RFC0793] Postel, J., "Transmission Control Protocol", STD 7, RFC 793, September 1981.

[RFC0952] Harrenstien, K., Stahl, M., and E. Feinler, "DoD Internet host table specification", RFC 952, October 1985.

[RFC1034] Mockapetris, P., "Domain names - concepts and facilities", STD 13, RFC 1034, November 1987.

[RFC1123] Braden, R., "Requirements for Internet Hosts - Application and Support", STD 3, RFC 1123, October 1989.

[RFC1930] Hawkinson, J. and T. Bates, "Guidelines for creation, selection, and registration of an Autonomous System (AS)", BCP 6, RFC 1930, March 1996.

[RFC2460] Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", RFC 2460, December 1998.

[RFC2474] Nichols, K., Blake, S., Baker, F., and D. Black, "Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers", RFC 2474, December 1998.

[RFC2578] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.

[RFC2579] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.

[RFC2780] Bradner, S. and V. Paxson, "IANA Allocation Guidelines For Values In the Internet Protocol and Related Headers", BCP 37, RFC 2780, March 2000.

[RFC2782] Gulbrandsen, A., Vixie, P., and L. Esibov, "A DNS RR for specifying the location of services (DNS SRV)", RFC 2782, February 2000.

[RFC2856] Bierman, A., McCloghrie, K., and R. Presuhn, "Textual Conventions for Additional High Capacity Data Types", RFC 2856, June 2000.

[RFC3289] Baker, F., Chan, K., and A. Smith, "Management Information Base for the Differentiated Services Architecture", RFC 3289, May 2002.

[RFC3305] Mealling, M. and R. Denenberg, "Report from the Joint W3C/IETF URI Planning Interest Group: Uniform Resource Identifiers (URIs), URLs, and Uniform Resource Names (URNs): Clarifications and Recommendations", RFC 3305, August 2002.

[RFC3595] Wijnen, B., "Textual Conventions for IPv6 Flow Label", RFC 3595, September 2003.

[RFC4001] Daniele, M., Haberman, B., Routhier, S., and J. Schoenwaelder, "Textual Conventions for Internet Network Addresses", RFC 4001, February 2005.

[RFC4271] Rekhter, Y., Li, T., and S. Hares, "A Border Gateway Protocol 4 (BGP-4)", RFC 4271, January 2006.

[RFC4340] Kohler, E., Handley, M., and S. Floyd, "Datagram Congestion Control Protocol (DCCP)", RFC 4340, March 2006.

[RFC4502] Waldbusser, S., "Remote Network Monitoring Management Information Base Version 2", RFC 4502, May 2006.

[RFC4960] Stewart, R., "Stream Control Transmission Protocol", RFC 4960, September 2007.

[RFC5017] McWalter, D., "MIB Textual Conventions for Uniform Resource Identifiers (URIs)", RFC 5017, September 2007.

[RFC5890] Klensin, J., "Internationalized Domain Names for Applications (IDNA): Definitions and Document Framework", RFC 5890, August 2010.

[RFC5952] Kawamura, S. and M. Kawashima, "A Recommendation for IPv6 Address Text Representation", RFC 5952, August 2010.

[RFC6021] Schoenwaelder, J., "Common YANG Data Types", RFC 6021, October 2010.

[RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", RFC 6241, June 2011.

[RFC6793] Vohra, Q. and E. Chen, "BGP Support for Four-Octet Autonomous System (AS) Number Space", RFC 6793, December 2012.

[XSD-TYPES] Biron, P. and A. Malhotra, "XML Schema Part 2: Datatypes Second Edition", World Wide Web Consortium Recommendation REC-xmlschema-2-20041028, October 2004, <http://www.w3.org/TR/2004/REC-xmlschema-2-20041028>.

Appendix A. Changes from RFC 6021

This version adds new type definitions to the YANG modules. The following new data types have been added to the ietf-yang-types module:

- yang-identifier
- hex-string
- uuid
- dotted-quad

The following new data types have been added to the ietf-inet-types module:

- ip-address-no-zone
- ipv4-address-no-zone
- ipv6-address-no-zone

Author's Address

Juergen Schoenwaelder (editor)
Jacobs University

EMail: j.schoenwaelder@jacobs-university.de