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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.

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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.

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     authors of the code.  All rights reserved.

     Redistribution and use in source and binary forms, with or
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     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.

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    authors of the code.  All rights reserved.

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

    This version of this YANG module is part of RFC 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)

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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:

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

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

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

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