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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.

Status of This Memo

This is an Internet Standards Track document.

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Table of Contents

1. Introduction	2
2. Overview	3
3. Core YANG Derived Types	4
4. Internet-Specific Derived Types	13
5. IANA Considerations	22
6. Security Considerations	23
7. Contributors	23
8. Acknowledgments	23
9. References	23
9.1. Normative References	23
9.2. Informative References	24

1. Introduction

YANG [RFC6020] is a data modeling language used to model configuration and state data manipulated by the Network Configuration Protocol (NETCONF) [RFC4741]. 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 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.

The derived types are generally designed to be applicable for modeling all areas of management information.

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).

ietf-yang-types

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
date-and-time	-
timeticks	TimeTicks (SNMPv2-SMI)
timestamp	TimeStamp (SNMPv2-TC)
phys-address	PhysAddress (SNMPv2-TC)
mac-address	MacAddress (SNMPv2-TC)
xpath1.0	-

Table 1

Table 2 lists the types defined in the ietf-inet-types YANG module and the corresponding SMIV2 types (if any).

ietf-inet-types

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-prefix	-
ipv4-prefix	-
ipv6-prefix	-
domain-name	-
host	-
uri	Uri (URI-TC-MIB)

Table 2

3. Core YANG Derived Types

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

```
<CODE BEGINS> file "ietf-yang-types@2010-09-24.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 Partain
              <mailto:david.partain@ericsson.com>
```

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

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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This version of this YANG module is part of RFC 6021; see the RFC itself for full legal notices."

```
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-identifier. 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)";
}
```

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

```
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";
  }
}

<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], [RFC3492], [RFC3595], [RFC3986], [RFC4001], [RFC4007], [RFC4271], [RFC4291], [RFC4340], [RFC4893], [RFC4960], [RFC5017], [RFC5891], and [RFC5952].

```
<CODE BEGINS> file "ietf-inet-types@2010-09-24.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 Partain
               <mailto:david.partain@ericsson.com>

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

    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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This version of this YANG module is part of RFC 6021; see the RFC itself for full legal notices."

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

/*** collection of protocol field related types ***/

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 flow-label type represents 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 autonomous system related types ***/

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 ASs'.  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 4893: BGP Support for Four-octet AS Number Space
   RFC 4001: Textual Conventions for Internet Network Addresses";
}

/*** collection of IP address and hostname related types ***/

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 representations
  implies the IP version.";
}

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 compressed format described in RFC 4291, Section 2.2, item 2 with the following additional rules: the :: substitution must be applied to the longest sequence of all-zero 16-bit chunks in an IPv6 address. If there is a tie, the first sequence of all-zero 16-bit chunks is replaced by ::. Single all-zero 16-bit chunks are not compressed. The canonical format uses lowercase characters and leading zeros are not allowed. The canonical format for the zone index is the numerical format as described in RFC 4007, Section 11.2."

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 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, IPv6 address is represented
    in the compressed format described in RFC 4291, Section
    2.2, item 2 with the following additional rules: the ::
    substitution must be applied to the longest sequence of
    all-zero 16-bit chunks in an IPv6 address. If there is
    a tie, the first sequence of all-zero 16-bit chunks is
    replaced by ::. Single all-zero 16-bit chunks are not
    compressed. The canonical format uses lowercase
    characters and leading zeros are not allowed.";
  reference
    "RFC 4291: IP Version 6 Addressing Architecture";
}
```

```
/** 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 it 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 encoded in punycode as described in RFC 3492";

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 3492: Punycode: A Bootstring encoding of Unicode for
              Internationalized Domain Names in Applications
              (IDNA)
    RFC 5891: Internationalizing Domain Names in Applications
              (IDNA): Protocol";
}
```

```
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 6021
```

```
name:      ietf-inet-types
namespace: urn:ietf:params:xml:ns:yang:ietf-inet-types
prefix:    inet
reference:  RFC 6021
```

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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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.
- [RFC3492] Costello, A., "Punycode: A Bootstring encoding of Unicode for Internationalized Domain Names in Applications (IDNA)", RFC 3492, March 2003.
- [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.
- [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 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.
- [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.
- [RFC4741] Enns, R., "NETCONF Configuration Protocol", RFC 4741, December 2006.
- [RFC4893] Vohra, Q. and E. Chen, "BGP Support for Four-octet AS Number Space", RFC 4893, May 2007.
- [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.
- [RFC5891] Klensin, J., "Internationalizing Domain Names in Applications (IDNA): Protocol", RFC 5891, August 2010.
- [RFC5952] Kawamura, S. and M. Kawashima, "A Recommendation for IPv6 Address Text Representation", RFC 5952, August 2010.
- [XSD-TYPES] Malhotra, A. and P. Biron, "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>>.

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