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Common YANG Data Types  
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Internet-Draft

YANG-TYPES

May 2009

## Abstract

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

## Table of Contents

<a href="#">1.</a>	Introduction . . . . .	<a href="#">4</a>
<a href="#">2.</a>	Overview . . . . .	<a href="#">5</a>
<a href="#">3.</a>	Core YANG Derived Types . . . . .	<a href="#">7</a>
<a href="#">4.</a>	Internet Specific Derived Types . . . . .	<a href="#">16</a>
<a href="#">5.</a>	IANA Considerations . . . . .	<a href="#">26</a>
<a href="#">6.</a>	Security Considerations . . . . .	<a href="#">27</a>
<a href="#">7.</a>	Contributors . . . . .	<a href="#">28</a>
<a href="#">8.</a>	Acknowledgments . . . . .	<a href="#">29</a>
<a href="#">9.</a>	References . . . . .	<a href="#">30</a>
<a href="#">9.1.</a>	Normative References . . . . .	<a href="#">30</a>
<a href="#">9.2.</a>	Informative References . . . . .	<a href="#">30</a>
<a href="#">Appendix A.</a>	XSD Translations . . . . .	<a href="#">33</a>
<a href="#">A.1.</a>	XSD of Core YANG Derived Types . . . . .	<a href="#">33</a>
<a href="#">A.2.</a>	XSD of Internet Specific Derived Types . . . . .	<a href="#">41</a>
<a href="#">Appendix B.</a>	RelaxNG Translations . . . . .	<a href="#">52</a>
<a href="#">B.1.</a>	RelaxNG of Core YANG Derived Types . . . . .	<a href="#">52</a>
<a href="#">B.2.</a>	RelaxNG of Internet Specific Derived Types . . . . .	<a href="#">59</a>
	Author's Address . . . . .	<a href="#">68</a>

## 1. Introduction

YANG [[YANG](#)] is a data modeling language used to model configuration and state data manipulated by the NETCONF [[RFC4741](#)] protocol. 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 over the types defined in subsequent sections and their equivalent SMIV2 data types. Table 1 list the types defined in the `ietf-yang-types` YANG module and the corresponding SMIV2 types (if any).

`ietf-yang-types`

Yang type	Equivalent SMIV2 type (module)
<code>counter32</code>	Counter32 (SNMPv2-SMI)
<code>zero-based-counter32</code>	ZeroBasedCounter32 (RMON2-MIB)
<code>counter64</code>	Counter64 (SNMPv2-SMI)
<code>zero-based-counter64</code>	ZeroBasedCounter64 (HCNUM-TC)
<code>gauge32</code>	Gauge32 (SNMPv2-SMI)
<code>gauge64</code>	CounterBasedGauge64 (HCNUM-TC)
<code>object-identifier</code>	-
<code>object-identifier-128</code>	OBJECT IDENTIFIER
<code>date-and-time</code>	-
<code>timeticks</code>	TimeTicks (SNMPv2-SMI)

timestamp	TimeStamp (SNMPv2-TC)	
phys-address	PhysAddress (SNMPv2-TC)	
mac-address	MacAddress (SNMPv2-TC)	
xpath1.0	-	
+-----+-----+		

Table 1

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

inet-yang-types

Yang type	Equivalent SMIV2 type (module)	
ip-version	-	
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

```

module ietf-yang-types {
    namespace "urn:ietf:params:xml:ns:yang: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 XXXX; see
the RFC itself for full legal notices.";
// RFC Ed.: replace XXXX with actual RFC number and remove this note

revision 2009-05-13 {
  description
    "Initial revision, published as RFC XXXX.";
}
// RFC Ed.: replace XXXX with actual RFC number and remove this note

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

```
typedef counter32 {
  type uint32;
  description
    "The counter32 type represents a non-negative integer
    which 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 an object instance using this type. If
    such other times can occur, for example, the creation of
    an object instance of type counter32 at times other than
    re-initialization, then a corresponding object should be
    defined, with an appropriate type, to indicate the last
    discontinuity.
```

The counter32 type should not be used for configuration

objects. A default statement should not be used for attributes with a type value of counter32.

This type is in the value set and its semantics 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 which has the defined `initial' value zero.
```

Objects of this type will be set to zero(0) on creation and will thereafter count appropriate events, wrapping back to zero(0) when the value  $2^{32}$  is reached.

Provided that an application discovers the new object within the minimum time to wrap it can use the initial value as a delta since it last polled the table of which this object is part. 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.

This type is in the value set and its semantics equivalent to the ZeroBasedCounter32 textual convention of the SMIV2.";

reference

"[RFC 2021](#): Remote Network Monitoring Management Information Base Version 2 using SMIV2";

```
}
```

```
typedef counter64 {
```

```
  type uint64;
```

```
  description
```

```
    "The counter64 type represents a non-negative integer which monotonically increases until it reaches a maximum value of  $2^{64}-1$  (18446744073709551615), 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 an object instance using this type. If such other times can occur, for example, the creation of an object instance of type counter64 at times other than re-initialization, then a corresponding object should be defined, with an appropriate type, to indicate the last discontinuity.

The counter64 type should not be used for configuration objects. A default statement should not be used for attributes with a type value of counter64.

This type is in the value set and its semantics 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 which has the defined `initial' value zero.
```

Objects of this type will be set to zero(0) on creation and will thereafter count appropriate events, wrapping back to zero(0) when the value 2<sup>64</sup> is reached.

Provided that an application discovers the new object within the minimum time to wrap it can use the initial value as a delta since it last polled the table of which this object is part. 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.

This type is in the value set and its semantics 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 can not be greater than  $2^{32}-1$  (4294967295 decimal), and the minimum value can not 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).

This type is in the value set and its semantics equivalent to the Counter32 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
        can not be greater than  $2^{64}-1$  (18446744073709551615), and
        the minimum value can not 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).
```

```

        This type is in the value set and its semantics 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
    white space.

    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.";
reference
    "ISO/IEC 9834-1: 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.

  This type is in the value set and its semantics 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 format is most easily described using the following ABFN (see [RFC 3339](#)):

```

date-fullyear   = 4DIGIT
date-month      = 2DIGIT  ; 01-12
date-mday       = 2DIGIT  ; 01-28, 01-29, 01-30, 01-31
time-hour       = 2DIGIT  ; 00-23
time-minute     = 2DIGIT  ; 00-59
time-second     = 2DIGIT  ; 00-58, 00-59, 00-60
time-secfrac    = "." 1*DIGIT
time-numoffset  = ("+" / "-") time-hour ":" time-minute
time-offset     = "Z" / time-numoffset

partial-time    = time-hour ":" time-minute ":" time-second
                  [time-secfrac]
full-date       = date-fullyear "-" date-month "-" date-mday
full-time       = partial-time time-offset

```

date-time = full-date "T" full-time

The date-and-time type is consistent with the semantics defined in [RFC 3339](#). The data-and-time type is compatible with the dateTime XML schema type with the following two notable exceptions:

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

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 mandates the UTC time format with the time-offset is indicated by the letter "Z". This is consistent with the canonical format used by the dateTime XML schema type.';

reference

"[RFC 3339](#): Date and Time on the Internet: Timestamps

[RFC 2579](#): Textual Conventions for SMIV2

W3C REC-xmlschema-2-20041028: XML Schema Part 2: Datatypes  
Second Edition";

}

typedef timeticks {

type uint32;

description

"The timeticks type represents a non-negative integer which represents the time, modulo 2<sup>32</sup> (4294967296 decimal), in hundredths of a second between two epochs. When objects are defined which use this type, the description of the object identifies both of the reference epochs.

This type is in the value set and its semantics 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 object at which a specific occurrence happened.
        The specific occurrence must be defined in the description
        of any object 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 object must be specified
        in the description of any object using this type.

        This type is in the value set and its semantics 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 '([0-9a0-fA-F]{2}(:[0-9a0-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.

        This type is in the value set and its semantics 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 802 MAC address represented
    in the `canonical' order defined by IEEE 802.1a, i.e., as if it
    were transmitted least significant bit first, even though 802.5
    (in contrast to other 802.x protocols) requires MAC addresses
    to be transmitted most significant bit first.

    This type is in the value set and its semantics equivalent to
    the MacAddress textual convention of the SMIV2.";
  reference
    "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.";
  reference
    "W3C REC-xpath-19991116: XML Path Language (XPath) Version 1.0";
}
}

```

#### 4. Internet Specific Derived Types

```
module ietf-inet-types {  
  
    namespace "urn:ietf:params:xml:ns:yang: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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```

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May 2009

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```
This version of this YANG module is part of RFC XXXX; see
the RFC itself for full legal notices.";
// RFC Ed.: replace XXXX with actual RFC number and remove this note

revision 2009-05-13 {
  description
    "Initial revision, published as RFC XXXX.";
}
// RFC Ed.: replace XXXX with actual RFC number and remove this note

/** 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."
```

```
    This type is in the value set and its semantics equivalent
    to the InetVersion textual convention of the SMIV2. However,
    the lexical appearance is different from the InetVersion
    textual convention.";
  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.

    This type is in the value set and its semantics 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.
```

```
  This type is in the value set and its semantics 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 "1..65535";
```

Schoenwaelder

Expires November 14, 2009

[Page 18]

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Internet-Draft

YANG-TYPES

May 2009

```
}
```

```
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 value zero is not a valid port number. A union
  type might be used in situations where the value zero is
  meaningful.
```

```
  This type is in the value set and its semantics equivalent
  to the InetPortNumber textual convention of the SMIV2.";
```

```
reference
```

```
"RFC 768: User Datagram Protocol
RFC 793: Transmission Control Protocol
RFC 2960: 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.

This type is in the value set and its semantics 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'
+   '|(1[0-9]{0,2})'|
+   '|(2(([0-4][0-9]?)|(5[0-5]?)|([6-9]?)))'|
+   '|([3-9][0-9]?)'|
+   ')'|
+   '\.){3}'
+   '(0'
+   '|(1[0-9]{0,2})'|
+   '|(2(([0-4][0-9]?)|(5[0-5]?)|([6-9]?)))'|
+   '|([3-9][0-9]?)'|
+   ')(%[\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 normalized format uses lower-case 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";

}

```
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 '((([0-1]?[0-9]?[0-9]|2[0-4][0-9]|25[0-5])\.){3}'  
        + '([0-1]?[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 which 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 which 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 normalized format uses lower-case
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 practise 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 objects 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 objects using the domain-name type MUST describe how (and when) 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 depends on the configuration of the resolver.

Internet-Draft

YANG-TYPES

May 2009

```
    The canonical format for domain-name values uses the
    US-ASCII encoding and case-insensitive characters are set
    to lowercase.";
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 3490: Internationalizing Domain Names in Applications
    (IDNA)";
}

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

This type is in the value set and its semantics 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)";

}

}

## 5. IANA Considerations

A registry for standard YANG modules shall be set up. The name of the registry is "IETF YANG Modules" and the registry shall record for each entry the unique name of a YANG module, the assigned XML namespace from the YANG URI Scheme, and a reference to the module's documentation (typically an RFC). Allocations require IETF Review as defined in [\[RFC5226\]](#). The initial assignments are:

YANG Module	XML namespace	Reference
ietf-yang-types	urn:ietf:params:xml:ns:yang:yang-types	RFC XXXX
ietf-inet-types	urn:ietf:params:xml:ns:yang:inet-types	RFC XXXX

RFC Ed.: replace XXXX with actual RFC number and remove this note

This document registers three URIs in the IETF XML registry [\[RFC3688\]](#). Following the format in [RFC 3688](#), the following registration is requested.

URI: urn:ietf:params:xml:ns:yang:yang-types  
URI: urn:ietf:params:xml:ns:yang:inet-types

Registrant Contact: The NETMOD WG of the IETF.

XML: N/A, the requested URI is an XML namespace.

## [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 [[YANG](#)] apply for this document as well.

## [7.](#) Contributors

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

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

## [8.](#) Acknowledgments

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### [9.1.](#) Normative References

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Internet-Draft

YANG-TYPES

May 2009

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[Page 31]

---

Internet-Draft

YANG-TYPES

May 2009

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## [Appendix A](#). XSD Translations

This appendix provides XML Schema (XSD) translations of the types defined in this document. This appendix is informative and not normative.

### [A.1](#). XSD of Core YANG Derived Types

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="urn:ietf:params:xml:ns:yang:yang-types"
  xmlns="urn:ietf:params:xml:ns:yang:yang-types"
  elementFormDefault="qualified"
  attributeFormDefault="unqualified"
  version="2009-05-13"
  xml:lang="en"
  xmlns:yang="urn:ietf:params:xml:ns:yang:yang-types">
```

```
<xs:annotation>
```

```
<xs:documentation>
```

```
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 XXXX; see the RFC itself for full legal notices.

```
</xs:documentation>
```

```
</xs:annotation>
```

```
<!-- YANG typedefs -->
```

```
<xs:simpleType name="counter32">
```

```
  <xs:annotation>
```

```
    <xs:documentation>
```

```
      The counter32 type represents a non-negative integer
```

which 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 an object instance using this type. If such other times can occur, for example, the creation of an object instance of type counter32 at times other than re-initialization, then a corresponding object should be defined, with an appropriate type, to indicate the last discontinuity.

The counter32 type should not be used for configuration objects. A default statement should not be used for attributes with a type value of counter32.

This type is in the value set and its semantics equivalent to the Counter32 type of the SMIV2.

```
</xs:documentation>
```

```
</xs:annotation>
```

```
<xs:restriction base="xs:unsignedInt">
```

```
</xs:restriction>
```

```
</xs:simpleType>
```

```
<xs:simpleType name="zero-based-counter32">
```

```
<xs:annotation>
```

```
<xs:documentation>
```

The zero-based-counter32 type represents a counter32 which has the defined `initial' value zero.

Objects of this type will be set to zero(0) on creation and will thereafter count appropriate events, wrapping back to zero(0) when the value  $2^{32}$  is reached.

Provided that an application discovers the new object within the minimum time to wrap it can use the initial value as a

delta since it last polled the table of which this object is part. 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.

This type is in the value set and its semantics equivalent to the ZeroBasedCounter32 textual convention of the SMIV2.

```
</xs:documentation>
</xs:annotation>

<xs:restriction base="yang:counter32">
</xs:restriction>
</xs:simpleType>

<xs:simpleType name="counter64">
  <xs:annotation>
    <xs:documentation>
      The counter64 type represents a non-negative integer
      which monotonically increases until it reaches a
      maximum value of 2^64-1 (18446744073709551615), 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 an object instance using this type. If
      such other times can occur, for example, the creation of
      an object instance of type counter64 at times other than
      re-initialization, then a corresponding object should be
      defined, with an appropriate type, to indicate the last
```

discontinuity.

The counter64 type should not be used for configuration objects. A default statement should not be used for attributes with a type value of counter64.

This type is in the value set and its semantics equivalent to the Counter64 type of the SMIV2.



```

    </xs:documentation>
  </xs:annotation>

  <xs:restriction base="xs:unsignedLong">
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="zero-based-counter64">
  <xs:annotation>
    <xs:documentation>
      The zero-based-counter64 type represents a counter64 which
      has the defined `initial' value zero.

      Objects of this type will be set to zero(0) on creation
      and will thereafter count appropriate events, wrapping
      back to zero(0) when the value 2^64 is reached.

      Provided that an application discovers the new object within
      the minimum time to wrap it can use the initial value as a
      delta since it last polled the table of which this object is
      part. 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.

      This type is in the value set and its semantics equivalent
      to the ZeroBasedCounter64 textual convention of the SMIV2.
    </xs:documentation>
  </xs:annotation>

  <xs:restriction base="yang:counter64">
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="gauge32">
  <xs:annotation>
    <xs:documentation>
      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

```

can not be greater than  $2^{32}-1$  (4294967295 decimal), and

the minimum value can not 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).

This type is in the value set and its semantics equivalent to the Counter32 type of the SMIV2.

```
</xs:documentation>
</xs:annotation>

<xs:restriction base="xs:unsignedInt">
</xs:restriction>
</xs:simpleType>

<xs:simpleType name="gauge64">
  <xs:annotation>
    <xs:documentation>
      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 can not be greater than 2^64-1 (18446744073709551615), and the minimum value can not 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).

      This type is in the value set and its semantics equivalent to the CounterBasedGauge64 SMIV2 textual convention defined in RFC 2856
    </xs:documentation>
  </xs:annotation>

  <xs:restriction base="xs:unsignedLong">
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="object-identifier">
  <xs:annotation>
    <xs:documentation>
```

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 white space.

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.

```
</xs:documentation>
</xs:annotation>

<xs:restriction base="xs:string">
  <xs:pattern value="((([0-1](\.[1-3]?[0-9]))|(2\.(0|([1-9]\d*)))
    )(\.(0|([1-9]\d*)))*)"/>
</xs:restriction>
</xs:simpleType>

<xs:simpleType name="object-identifier-128">
  <xs:annotation>
    <xs:documentation>
      This type represents object-identifiers restricted to 128
      sub-identifiers.

      This type is in the value set and its semantics equivalent
      to the OBJECT IDENTIFIER type of the SMIV2.
    </xs:documentation>
  </xs:annotation>

  <xs:restriction base="object-identifier">
    <xs:pattern value="\d*(.\d*){1,127}"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="date-and-time">
  <xs:annotation>
    <xs:documentation>
      The date-and-time type is a profile of the ISO 8601
      standard for representation of dates and times using the
```

Gregorian calendar. The format is most easily described using the following ABFN (see [RFC 3339](#)):

```
date-fullyear   = 4DIGIT
date-month     = 2DIGIT ; 01-12
date-mday      = 2DIGIT ; 01-28, 01-29, 01-30, 01-31
time-hour      = 2DIGIT ; 00-23
time-minute    = 2DIGIT ; 00-59
time-second    = 2DIGIT ; 00-58, 00-59, 00-60
time-secfrac   = "." 1*DIGIT
time-numoffset = ("+" / "-") time-hour ":" time-minute
time-offset    = "Z" / time-numoffset

partial-time    = time-hour ":" time-minute ":" time-second
                  [time-secfrac]
full-date       = date-fullyear "-" date-month "-" date-mday
full-time       = partial-time time-offset

date-time       = full-date "T" full-time
```

The date-and-time type is consistent with the semantics defined in [RFC 3339](#). The data-and-time type is compatible with the dateTime XML schema type with the following two notable exceptions:

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

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 mandates the UTC time format with the time-offset is indicated by the letter "Z". This is consistent with the canonical format used by the dateTime XML schema type.

```
</xs:documentation>
</xs:annotation>
```

```

<xs:restriction base="xs:string">
  <xs:pattern value="\d{4}-\d{2}-\d{2}T\d{2}:\d{2}:\d{2}(\.\d+)?
    (Z|(\+|-)\d{2}:\d{2})"/>
</xs:restriction>
</xs:simpleType>

<xs:simpleType name="timeticks">
  <xs:annotation>

```

```

<xs:documentation>
  The timeticks type represents a non-negative integer which
  represents the time, modulo 2^32 (4294967296 decimal), in
  hundredths of a second between two epochs. When objects
  are defined which use this type, the description of the
  object identifies both of the reference epochs.

  This type is in the value set and its semantics equivalent
  to the TimeTicks type of the SMIV2.
</xs:documentation>
</xs:annotation>

<xs:restriction base="xs:unsignedInt">
</xs:restriction>
</xs:simpleType>

<xs:simpleType name="timestamp">
  <xs:annotation>
    <xs:documentation>
      The timestamp type represents the value of an associated
      timeticks object at which a specific occurrence happened.
      The specific occurrence must be defined in the description
      of any object 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 object must be specified
      in the description of any object using this type.
    </xs:documentation>
  </xs:annotation>

```

This type is in the value set and its semantics equivalent to the TimeStamp textual convention of the SMIV2.

```
</xs:documentation>
</xs:annotation>
```

```
<xs:restriction base="yang:timeticks">
</xs:restriction>
</xs:simpleType>
```

```
<xs:simpleType name="phys-address">
<xs:annotation>
<xs:documentation>
Represents media- or physical-level addresses represented
as a sequence octets, each octet represented by two hexadecimal
numbers. Octets are separated by colons.
```

This type is in the value set and its semantics equivalent to the PhysAddress textual convention of the SMIV2.

```
</xs:documentation>
</xs:annotation>
```

```
<xs:restriction base="xs:string">
<xs:pattern value="([0-9a0-fA-F]{2}(:[0-9a0-fA-F]{2})*)?"/>
</xs:restriction>
</xs:simpleType>
```

```
<xs:simpleType name="mac-address">
<xs:annotation>
<xs:documentation>
The mac-address type represents an 802 MAC address represented
in the `canonical' order defined by IEEE 802.1a, i.e., as if it
were transmitted least significant bit first, even though 802.5
(in contrast to other 802.x protocols) requires MAC addresses
to be transmitted most significant bit first.
```

This type is in the value set and its semantics equivalent to the MacAddress textual convention of the SMIV2.

```
</xs:documentation>
</xs:annotation>
```

```
<xs:restriction base="xs:string">
```

```

    <xs:pattern value="[0-9a-fA-F]{2}(:[0-9a-fA-F]{2}){5}"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="xpath1.0">
  <xs:annotation>
    <xs:documentation>
      This type represents an XPATH 1.0 expression.
    </xs:documentation>
  </xs:annotation>

  <xs:restriction base="xs:string">
  </xs:restriction>
</xs:simpleType>

</xs:schema>

```

## [A.2.](#) XSD of Internet Specific Derived Types

```

<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="urn:ietf:params:xml:ns:yang:inet-types"

```

```

  xmlns="urn:ietf:params:xml:ns:yang:inet-types"
  elementFormDefault="qualified"
  attributeFormDefault="unqualified"
  version="2009-05-13"
  xml:lang="en"
  xmlns:inet="urn:ietf:params:xml:ns:yang:inet-types">

```

```

<xs:annotation>
  <xs:documentation>
    This module contains a collection of generally useful derived
    YANG data types for Internet addresses and related things.

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    the document authors. All rights reserved.

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    without modification, are permitted provided that the
    following conditions are met:

```

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```

    This version of this YANG module is part of RFC XXXX; see
    the RFC itself for full legal notices.
  </xs:documentation>
</xs:annotation>

<!-- YANG typedefs -->

<xs:simpleType name="ip-version">
  <xs:annotation>
    <xs:documentation>
      This value represents the version of the IP protocol.
    
```



This type is in the value set and its semantics equivalent to the InetVersion textual convention of the SMIV2. However, the lexical appearance is different from the InetVersion textual convention.

```
</xs:documentation>
</xs:annotation>

<xs:restriction base="xs:string">
  <xs:enumeration value="unknown"/>
  <xs:enumeration value="ipv4"/>
  <xs:enumeration value="ipv6"/>
</xs:restriction>
</xs:simpleType>

<xs:simpleType name="dscp">
  <xs:annotation>
    <xs:documentation>
      The dscp type represents a Differentiated Services Code-Point
      that may be used for marking packets in a traffic stream.

      This type is in the value set and its semantics equivalent
      to the Dscp textual convention of the SMIV2.
    </xs:documentation>
  </xs:annotation>

  <xs:restriction base="xs:unsignedByte">
    <xs:minInclusive value="0"/>
    <xs:maxInclusive value="63"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="ipv6-flow-label">
  <xs:annotation>
    <xs:documentation>
      The flow-label type represents flow identifier or Flow Label
      in an IPv6 packet header that may be used to discriminate
```

traffic flows.

This type is in the value set and its semantics equivalent to the IPv6FlowLabel textual convention of the SMIV2.

```

    </xs:documentation>
</xs:annotation>

<xs:restriction base="xs:unsignedInt">
  <xs:minInclusive value="0"/>
  <xs:maxInclusive value="1048575"/>
</xs:restriction>
</xs:simpleType>

<xs:simpleType name="port-number">
  <xs:annotation>
    <xs:documentation>
      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 value zero is not a valid port number. A union
      type might be used in situations where the value zero is
      meaningful.

      This type is in the value set and its semantics equivalent
      to the InetPortNumber textual convention of the SMIV2.
    </xs:documentation>
  </xs:annotation>

  <xs:restriction base="xs:unsignedShort">
    <xs:minInclusive value="1"/>
    <xs:maxInclusive value="65535"/>
  </xs:restriction>
</xs:simpleType>

<xs:simpleType name="as-number">
  <xs:annotation>
    <xs:documentation>
      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.
    </xs:documentation>
  </xs:annotation>
</xs:simpleType>

```

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.

This type is in the value set and its semantics equivalent to the InetAutonomousSystemNumber textual convention of the SMIV2.

```
</xs:documentation>
</xs:annotation>

<xs:restriction base="xs:unsignedInt">
</xs:restriction>
</xs:simpleType>

<xs:simpleType name="ip-address">
  <xs:annotation>
    <xs:documentation>
      The ip-address type represents an IP address and is IP
      version neutral. The format of the textual representations
      implies the IP version.
    </xs:documentation>
  </xs:annotation>

  <xs:union>
    <xs:simpleType>
      <xs:restriction base="inet:ipv4-address">
      </xs:restriction>
    </xs:simpleType>
    <xs:simpleType>
      <xs:restriction base="inet:ipv6-address">
      </xs:restriction>
    </xs:simpleType>
  </xs:union>
</xs:simpleType>

<xs:simpleType name="ipv4-address">
  <xs:annotation>
    <xs:documentation>
      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

```
</xs:documentation>
</xs:annotation>

<xs:restriction base="xs:string">
  <xs:pattern value="((0|(1[0-9]{0,2})|(2((([0-4][0-9]?)|(5[0-5]?
    )|([6-9]?)))|([3-9][0-9]?))\.)}{3}(0|(1[0-9]{
    0,2})|(2((([0-4][0-9]?)|(5[0-5]?|([6-9]?)))|
    ([3-9][0-9]?)))(%[\p{N}\p{L}]+)?">
</xs:restriction>
</xs:simpleType>

<xs:simpleType name="ipv6-address">
  <xs:annotation>
    <xs:documentation>
      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 normalized
      format uses lower-case 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.
    </xs:documentation>
  </xs:annotation>

```

```
</xs:annotation>
```

```
<xs:restriction>
```

```
<xs:simpleType>
```

```
<xs:restriction base="xs:string">
```

```
<xs:pattern value="(([\^:]+\:){6}([\^:]+\:|(\.\*\.\*\.\*)))|([\^:]+\:)*[\^:]+\:?:([\^:]+\:)*[\^:]+\:?(%.\+)?"/>
```

```
</xs:restriction>
```

```
</xs:simpleType>
```

```
<xs:pattern value="((:|[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}]+)?"/>
```

```
</xs:restriction>
```

```
</xs:simpleType>
```

```
<xs:simpleType name="ip-prefix">
```

```
<xs:annotation>
```

```
<xs:documentation>
```

```
The ip-prefix type represents an IP prefix and is IP version neutral. The format of the textual representations implies the IP version.
```

```
</xs:documentation>
```

```
</xs:annotation>
```

```
<xs:union>
```

```
<xs:simpleType>
```

```
<xs:restriction base="inet:ipv4-prefix">
```

```
</xs:restriction>
```

```
</xs:simpleType>
```

```
<xs:simpleType>
```

```
<xs:restriction base="inet:ipv6-prefix">
```

```
</xs:restriction>
```

```
</xs:simpleType>
```

```
</xs:union>
```

```
</xs:simpleType>
```

```
<xs:simpleType name="ipv4-prefix">
```

```
<xs:annotation>
```

<xs:documentation>

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 which 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.

</xs:documentation>

</xs:annotation>

<xs:restriction base="xs:string">

<xs:pattern value="(([0-1]?[0-9]?[0-9]|2[0-4][0-9]|25[0-5])\.)  
{3}([0-1]?[0-9]?[0-9]|2[0-4][0-9]|25[0-5])/  
([0-9])|([1-2][0-9])|(3[0-2]))"/>

</xs:restriction>

</xs:simpleType>

<xs:simpleType name="ipv6-prefix">

<xs:annotation>

<xs:documentation>

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 which 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 normalized format uses lower-case characters and leading zeros are not allowed.

```
</xs:documentation>
</xs:annotation>

<xs:restriction>
  <xs:simpleType>
    <xs:restriction base="xs:string">
      <xs:pattern value="(([^:]+){6}(([^:]+:[^:]+)|(.*\..*)))|((
        ([^:]+)*[^\:]+)?::(([^:]+)*[^\:]+)?(/.
        +)"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:pattern value="((:|[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]]))"/>
    </xs:restriction>
  </xs:simpleType>

  <xs:simpleType name="domain-name">
    <xs:annotation>
      <xs:documentation>
        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 practise 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 objects 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 objects using the domain-name type MUST describe how (and when) 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 depends on the configuration of the resolver.

The canonical format for domain-name values uses the US-ASCII encoding and case-insensitive characters are set to lowercase.

```
</xs:documentation>
</xs:annotation>

<xs:restriction base="t0">
  <xs:minLength value="1"/>
  <xs:maxLength value="253"/>
</xs:restriction>
</xs:simpleType>
```

```
<xs:simpleType name="host">
  <xs:annotation>
    <xs:documentation>
      The host type represents either an IP address or a DNS
      domain name.
    </xs:documentation>
  </xs:annotation>

  <xs:union>
    <xs:simpleType>
      <xs:restriction base="inet:ip-address">
        </xs:restriction>
```



```
</xs:simpleType>
<xs:simpleType>
  <xs:restriction base="inet:domain-name">
    </xs:restriction>
  </xs:simpleType>
</xs:union>
</xs:simpleType>
```

```
<xs:simpleType name="uri">
  <xs:annotation>
    <xs:documentation>
      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

This type is in the value set and its semantics equivalent

```
    to the Uri SMIV2 textual convention defined in RFC 5017.
  </xs:documentation>
</xs:annotation>

<xs:restriction base="xs:string">
```

```
</xs:restriction>
</xs:simpleType>

<!-- locally generated simpleType helpers -->

<xs:simpleType name="t0">
  <xs:restriction base="xs:string">
    <xs:pattern value="((([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]\.?)|\."/>
  </xs:restriction>
</xs:simpleType>

</xs:schema>
```

## [Appendix B](#). RelaxNG Translations

This appendix provides RelaxNG translations of the types defined in this document. This appendix is informative and not normative.

### [B.1](#). RelaxNG of Core YANG Derived Types

```
namespace a = "http://relaxng.org/ns/compatibility/annotations/1.0"
namespace dc = "http://purl.org/dc/terms"
namespace dsrl = "http://purl.oclc.org/dsdl/dsrl"
namespace nm = "urn:ietf:params:xml:ns:netmod:dSDL-attr:1"
namespace sch = "http://purl.oclc.org/dsdl/schematron"
namespace yang = "urn:ietf:params:xml:ns:yang:yang-types"
```

```
dc:creator [
  "IETF NETMOD (NETCONF Data Modeling Language) Working Group"
]
dc:description [
  "This module contains a collection of generally useful derived\x{a}" ~
  "YANG data types.\x{a}" ~
  "\x{a}" ~
  "Copyright (c) 2009 IETF Trust and the persons identified as\x{a}" ~
  "the document authors. All rights reserved.\x{a}" ~
  "\x{a}" ~
  "Redistribution and use in source and binary forms, with or\x{a}" ~
  "without modification, are permitted provided that the\x{a}" ~
  "following conditions are met:\x{a}" ~
  "\x{a}" ~
  "- Redistributions of source code must retain the above\x{a}" ~
  " copyright notice, this list of conditions and the\x{a}" ~
  " following disclaimer.\x{a}" ~
  "\x{a}" ~
  "- Redistributions in binary form must reproduce the above\x{a}" ~
  " copyright notice, this list of conditions and the\x{a}" ~
  " following disclaimer in the documentation and/or other\x{a}" ~
  " materials provided with the distribution.\x{a}" ~
  "\x{a}" ~
  "- Neither the name of Internet Society, IETF or IETF\x{a}" ~
  " Trust, nor the names of specific contributors, may be\x{a}" ~
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  " software without specific prior written permission.\x{a}" ~
  "\x{a}" ~
  "THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND\x{a}" ~
  "CONTRIBUTORS 'AS IS' AND ANY EXPRESS OR IMPLIED\x{a}" ~
  "WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED\x{a}" ~
  "WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR\x{a}" ~
  "PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT\x{a}" ~
  "OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT,\x{a}" ~
```

Internet-Draft

YANG-TYPES

May 2009

```
"INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES\{a}" ~
"(INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE\{a}" ~
"GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR\{a}" ~
"BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF\{a}" ~
"LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT\{a}" ~
"(INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT\{a}" ~
"OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE\{a}" ~
"POSSIBILITY OF SUCH DAMAGE.\{a}" ~
"\{a}" ~
"This version of this YANG module is part of RFC XXXX; see\{a}" ~
"the RFC itself for full legal notices."
]
dc:issued [ "2009-05-13" ]
dc:source [ "YANG module 'ietf-yang-types' (automatic translation)" ]
dc:contributor [
  "WG Web: <http://tools.ietf.org/wg/netmod/>\{a}" ~
  "WG List: <mailto:netmod@ietf.org>\{a}" ~
  "\{a}" ~
  "WG Chair: David Partain\{a}" ~
  " <mailto:david.partain@ericsson.com>\{a}" ~
  "\{a}" ~
  "WG Chair: David Kessens\{a}" ~
  " <mailto:david.kessens@nsn.com>\{a}" ~
  "\{a}" ~
  "Editor: Juergen Schoenwaelder\{a}" ~
  " <mailto:j.schoenwaelder@jacobs-university.de>"
]
```

```
## The counter32 type represents a non-negative integer
## which 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 an object instance using this type. If
## such other times can occur, for example, the creation of
## an object instance of type counter32 at times other than
## re-initialization, then a corresponding object should be
```

```
## defined, with an appropriate type, to indicate the last
## discontinuity.
##
## The counter32 type should not be used for configuration
## objects. A default statement should not be used for
## attributes with a type value of counter32.
```

```
##
## This type is in the value set and its semantics equivalent
## to the Counter32 type of the SMIV2.

## See: RFC 2578: Structure of Management Information Version 2 (SMIV2)
counter32 = xsd:unsignedInt

## The zero-based-counter32 type represents a counter32
## which has the defined `initial' value zero.
##
## Objects of this type will be set to zero(0) on creation
## and will thereafter count appropriate events, wrapping
## back to zero(0) when the value 2^32 is reached.
##
## Provided that an application discovers the new object within
## the minimum time to wrap it can use the initial value as a
## delta since it last polled the table of which this object is
## part. 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.
##
## This type is in the value set and its semantics equivalent
## to the ZeroBasedCounter32 textual convention of the SMIV2.

## See: RFC 2021: Remote Network Monitoring Management Information
## Base Version 2 using SMIV2
zero-based-counter32 = counter32 >> dsrl:default-content [ "0" ]

## The counter64 type represents a non-negative integer
## which monotonically increases until it reaches a
## maximum value of 2^64-1 (18446744073709551615), 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 an object instance using this type. If  
## such other times can occur, for example, the creation of  
## an object instance of type counter64 at times other than  
## re-initialization, then a corresponding object should be  
## defined, with an appropriate type, to indicate the last  
## discontinuity.  
##  
## The counter64 type should not be used for configuration  
## objects. A default statement should not be used for

## attributes with a type value of counter64.  
##  
## This type is in the value set and its semantics equivalent  
## to the Counter64 type of the SMIV2.  
  
## See: [RFC 2578](#): Structure of Management Information Version 2 (SMIV2)  
counter64 = xsd:unsignedLong  
  
## The zero-based-counter64 type represents a counter64 which  
## has the defined `initial' value zero.  
##  
## Objects of this type will be set to zero(0) on creation  
## and will thereafter count appropriate events, wrapping  
## back to zero(0) when the value 2<sup>64</sup> is reached.  
##  
## Provided that an application discovers the new object within  
## the minimum time to wrap it can use the initial value as a  
## delta since it last polled the table of which this object is  
## part. 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.  
##  
## This type is in the value set and its semantics equivalent  
## to the ZeroBasedCounter64 textual convention of the SMIV2.  
  
## See: [RFC 2856](#): Textual Conventions for Additional High Capacity  
## Data Types

zero-based-counter64 = counter64 >> dsrl:default-content [ "0" ]

## 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  
## can not be greater than  $2^{32}-1$  (4294967295 decimal), and  
## the minimum value can not 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).

##

## This type is in the value set and its semantics equivalent  
## to the Counter32 type of the SMIV2.

## See: [RFC 2578](#): Structure of Management Information Version 2 (SMIV2)

gauge32 = xsd:unsignedInt

## 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  
## can not be greater than  $2^{64}-1$  (18446744073709551615), and  
## the minimum value can not 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).

##

## This type is in the value set and its semantics equivalent  
## to the CounterBasedGauge64 SMIV2 textual convention defined  
## in [RFC 2856](#)

## See: [RFC 2856](#): Textual Conventions for Additional High Capacity  
## Data Types

gauge64 = xsd:unsignedLong

```

## 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
## white space.
##
## 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.

## See: ISO/IEC 9834-1: 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
object-identifier =
  xsd:string {
    pattern =
      "(([0-1](\.[1-3]?[0-9]))|(2\.(0|([1-9]\d*))))(\.(0|([1-9]\d*)))*"
  }

```

```

## This type represents object-identifiers restricted to 128
## sub-identifiers.
##
## This type is in the value set and its semantics equivalent
## to the OBJECT IDENTIFIER type of the SMIV2.

## See: RFC 2578: Structure of Management Information Version 2 (SMIV2)
object-identifier-128 = object-identifier

## The date-and-time type is a profile of the ISO 8601
## standard for representation of dates and times using the
## Gregorian calendar. The format is most easily described
## using the following ABFN (see RFC 3339):
##

```



```

## date-fullyear    = 4DIGIT
## date-month      = 2DIGIT ; 01-12
## date-mday       = 2DIGIT ; 01-28, 01-29, 01-30, 01-31
## time-hour       = 2DIGIT ; 00-23
## time-minute     = 2DIGIT ; 00-59
## time-second     = 2DIGIT ; 00-58, 00-59, 00-60
## time-secfrac    = "." 1*DIGIT
## time-numoffset  = ("+" / "-") time-hour ":" time-minute
## time-offset     = "Z" / time-numoffset
##
## partial-time    = time-hour ":" time-minute ":" time-second
##                  [time-secfrac]
## full-date       = date-fullyear "-" date-month "-" date-mday
## full-time       = partial-time time-offset
##
## date-time       = full-date "T" full-time
##
## The date-and-time type is consistent with the semantics defined
## in RFC 3339. The data-and-time type is compatible with the
## dateTime XML schema type with the following two notable
## exceptions:
##
## (a) The data-and-time type does not allow negative years.
##
## (b) The data-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.
##
## 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 mandates the UTC

```

```

## time format with the time-offset is indicated by the letter "Z".
## This is consistent with the canonical format used by the
## dateTime XML schema type.

```

```

## See: RFC 3339: Date and Time on the Internet: Timestamps
## RFC 2579: Textual Conventions for SMIV2
## W3C REC-xmlschema-2-20041028: XML Schema Part 2: Datatypes

```

```

##          Second Edition
date-and-time =
  xsd:string {
    pattern =
      "\d{4}-\d{2}-\d{2}T\d{2}:\d{2}:\d{2}(\.\d+)?(Z|(\+|-)\d{2}:\d{2})"
  }

## The timeticks type represents a non-negative integer which
## represents the time, modulo 2^32 (4294967296 decimal), in
## hundredths of a second between two epochs. When objects
## are defined which use this type, the description of the
## object identifies both of the reference epochs.
##
## This type is in the value set and its semantics equivalent
## to the TimeTicks type of the SMIV2.

## See: RFC 2578: Structure of Management Information Version 2 (SMIV2)
timeticks = xsd:unsignedInt

## The timestamp type represents the value of an associated
## timeticks object at which a specific occurrence happened.
## The specific occurrence must be defined in the description
## of any object 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 object must be specified
## in the description of any object using this type.
##
## This type is in the value set and its semantics equivalent
## to the TimeStamp textual convention of the SMIV2.

## See: RFC 2579: Textual Conventions for SMIV2
timestamp = timeticks

## Represents media- or physical-level addresses represented
## as a sequence octets, each octet represented by two hexadecimal
## numbers. Octets are separated by colons.

```

```
##
## This type is in the value set and its semantics equivalent
## to the PhysAddress textual convention of the SMIV2.
```

```
## See: RFC 2579: Textual Conventions for SMIV2
```

```
phys-address =
  xsd:string { pattern = "([0-9a0-fA-F]{2}(:[0-9a0-fA-F]{2})*)?" }
```

```
## The mac-address type represents an 802 MAC address represented
## in the `canonical' order defined by IEEE 802.1a, i.e., as if it
## were transmitted least significant bit first, even though 802.5
## (in contrast to other 802.x protocols) requires MAC addresses
## to be transmitted most significant bit first.
```

```
##
## This type is in the value set and its semantics equivalent to
## the MacAddress textual convention of the SMIV2.
```

```
## See: RFC 2579: Textual Conventions for SMIV2
```

```
mac-address =
  xsd:string { pattern = "[0-9a-fA-F]{2}(:[0-9a-fA-F]{2}){5}" }
```

```
## This type represents an XPATH 1.0 expression.
```

```
## See: W3C REC-xpath-19991116: XML Path Language (XPath) Version 1.0
xpath1.0 = xsd:string
```

## [B.2.](#) RelaxNG of Internet Specific Derived Types

```
namespace a = "http://relaxng.org/ns/compatibility/annotations/1.0"
namespace dc = "http://purl.org/dc/terms"
namespace dsrl = "http://purl.oclc.org/dsdl/dsrl"
namespace inet = "urn:ietf:params:xml:ns:yang:inet-types"
namespace nm = "urn:ietf:params:xml:ns:netmod:dsdl-attr:1"
namespace sch = "http://purl.oclc.org/dsdl/schematron"
```

```
dc:creator [
  "IETF NETMOD (NETCONF Data Modeling Language) Working Group"
]
dc:description [
  "This module contains a collection of generally useful derived\x{a}" ~
  "YANG data types for Internet addresses and related things.\x{a}" ~
  "\x{a}" ~
  "Copyright (c) 2009 IETF Trust and the persons identified as\x{a}" ~
  "the document authors. All rights reserved.\x{a}" ~
  "\x{a}" ~
  "Redistribution and use in source and binary forms, with or\x{a}" ~
  "without modification, are permitted provided that the\x{a}" ~
  "following conditions are met:\x{a}" ~
```

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May 2009

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"POSSIBILITY OF SUCH DAMAGE.\x{a}" ~
"\x{a}" ~
"This version of this YANG module is part of RFC XXXX; see \x{a}" ~
"the RFC itself for full legal notices."
]
dc:issued [ "2009-05-13" ]
dc:source [ "YANG module 'ietf-inet-types' (automatic translation)" ]
dc:contributor [
  "WG Web: <http://tools.ietf.org/wg/netmod/>\x{a}" ~
  "WG List: <mailto:netmod@ietf.org>\x{a}" ~
  "\x{a}" ~
  "WG Chair: David Partain\x{a}" ~
  " <mailto:david.partain@ericsson.com>\x{a}" ~
  "\x{a}" ~
  "WG Chair: David Kessens\x{a}" ~
```

```
"      <mailto:david.kessens@nsn.com>\x{a}" ~
"\x{a}" ~
"Editor:  Juergen Schoenwaelder\x{a}" ~
"      <mailto:j.schoenwaelder@jacobs-university.de>"
]
```

Schoenwaelder

Expires November 14, 2009

[Page 60]

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Internet-Draft

YANG-TYPES

May 2009

```
## This value represents the version of the IP protocol.
##
## This type is in the value set and its semantics equivalent
## to the InetVersion textual convention of the SMIV2. However,
## the lexical appearance is different from the InetVersion
## textual convention.

## See: RFC 791: Internet Protocol
## RFC 2460: Internet Protocol, Version 6 (IPv6) Specification
## RFC 4001: Textual Conventions for Internet Network Addresses
ip-version = "unknown" | "ipv4" | "ipv6"

## The dscp type represents a Differentiated Services Code-Point
## that may be used for marking packets in a traffic stream.
##
## This type is in the value set and its semantics equivalent
## to the Dscp textual convention of the SMIV2.

## See: 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
dscp = xsd:unsignedByte { minInclusive = "0" maxInclusive = "63" }

## The flow-label type represents flow identifier or Flow Label
## in an IPv6 packet header that may be used to discriminate
## traffic flows.
##
## This type is in the value set and its semantics equivalent
## to the IPv6FlowLabel textual convention of the SMIV2.

## See: RFC 3595: Textual Conventions for IPv6 Flow Label
## RFC 2460: Internet Protocol, Version 6 (IPv6) Specification
ipv6-flow-label =
```

```
xsd:unsignedInt { minInclusive = "0" maxInclusive = "1048575" }
```

```
## 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 value zero is not a valid port number. A union
## type might be used in situations where the value zero is
## meaningful.
##
## This type is in the value set and its semantics equivalent
```

Schoenwaelder

Expires November 14, 2009

[Page 61]

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Internet-Draft

YANG-TYPES

May 2009

```
## to the InetPortNumber textual convention of the SMIV2.
```

```
## See: RFC 768: User Datagram Protocol
## RFC 793: Transmission Control Protocol
## RFC 2960: Stream Control Transmission Protocol
## RFC 4340: Datagram Congestion Control Protocol (DCCP)
## RFC 4001: Textual Conventions for Internet Network Addresses
port-number =
  xsd:unsignedShort { minInclusive = "1" maxInclusive = "65535" }
```

```
## 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.
##
## This type is in the value set and its semantics equivalent
## to the InetAutonomousSystemNumber textual convention of
## the SMIV2.
```

```
## See: 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
as-number = xsd:unsignedInt
```

```
## The ip-address type represents an IP address and is IP
## version neutral. The format of the textual representations
## implies the IP version.
ip-address = ipv4-address | ipv6-address
```

```
## 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
```

```
ipv4-address =
  xsd:string {
    pattern =
      "((0|(1[0-9]{0,2})|(2([0-4][0-9]?)|(5[0-5]?)|([6-9]?))"
      ~ ")|([3-9][0-9]?))\.)\{3}(0|(1[0-9]{0,2})|(2([0-4][0-9]?)|(5["
      ~ "0-5]?)|([6-9]?))|([3-9][0-9]?))([\p{N}\p{L}]+)?"
  }
```

```
## 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 normalized
## format uses lower-case 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.

## See: RFC 4291: IP Version 6 Addressing Architecture
## RFC 4007: IPv6 Scoped Address Architecture
ipv6-address =
  xsd: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}((([^\:]+\:)+)|(\.*\.*)))|(((([^\:]+\:)+)*[^\:]"
      ~ "+)?::((([^\:]+\:)+)*[^\:]?)?(%.+)?)"
  }

```

```

## The ip-prefix type represents an IP prefix and is IP
## version neutral. The format of the textual representations
## implies the IP version.

```

```

ip-prefix = ipv4-prefix | ipv6-prefix

```

```

## 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 which 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.
ipv4-prefix =
  xsd:string {
    pattern =
      "(([0-1]?[0-9]?[0-9]|2[0-4][0-9]|25[0-5])\.){3}([0-1]?
~ "[0-9]?[0-9]|2[0-4][0-9]|25[0-5])/((([0-9])|([1-2][0-9])|(3[0-
~ "2])))"
  }

```

```

## 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 which 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 normalized format uses lower-case
## characters and leading zeros are not allowed.

```

```

## See: RFC 4291: IP Version 6 Addressing Architecture

```

```

ipv6-prefix =
  xsd: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]{2})|(1[0-1][0-9])|(12[0-8])))"
    pattern =

```

```
    "(((^[^:]+:){6}(((^[^:]+:[^:]+)|(.*\..*)))|(((^[^:]+:)*[^:]~
~ "+)?::((^[^:]+:)*[^:]?) (/.)+)"
}
```

```
## 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 practise 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
## objects 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 objects using the domain-name
## type MUST describe how (and when) 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
## depends on the configuration of the resolver.
##
## The canonical format for domain-name values uses the
## US-ASCII encoding and case-insensitive characters are set
## to lowercase.

## See: RFC 952: DoD Internet Host Table Specification
## RFC 1034: Domain Names - Concepts and Facilities
```

```

##          and Support
## RFC 3490: Internationalizing Domain Names in Applications
##          (IDNA)
domain-name =
  xsd: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]\.?)|\."
    minLength = "1"
    maxLength = "253"
  }

## The host type represents either an IP address or a DNS
## domain name.
host = ip-address | domain-name

## 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
##
## This type is in the value set and its semantics equivalent
## to the Uri SMIV2 textual convention defined in RFC 5017.

## See: 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)  
uri = xsd:string

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[Page 68]