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I2NSF Network Security Function-Facing Interface YANG Data Model
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Abstract

This document defines a YANG data model for configuring security policy rules on network security functions. The YANG data model in this document is corresponding to the information model for Network Security Functions (NSF)-Facing Interface in Interface to Network Security Functions (I2NSF).

Status of This Memo

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1. Introduction

This document defines a YANG [RFC6020][RFC7950] data model for security policy rule configuration of network security devices. The YANG data model is corresponding to the information model [i2nsf-nsf-cap-im] for Network Security Functions (NSF) facing interface in Interface to Network Security Functions (I2NSF). The YANG data model in this document focuses on security policy configuration for generic network security functions. Note that security policy configuration for advanced network security functions are written in [i2nsf-advanced-nsf-dm].
This YANG data model uses an "Event-Condition-Action" (ECA) policy model that is used as the basis for the design of I2NSF Policy described in [RFC8329] and [i2nsf-nsf-cap-im].

The "ietf-i2nsf-policy-rule-for-nsf" YANG module defined in this document provides the following features.

- Configuration for general security policy rule of generic network security function.
- Configuration for an event clause of generic network security function.
- Configuration for a condition clause of generic network security function.
- Configuration for an action clause of generic network security function.

2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119][RFC8174].

3. Terminology

This document uses the terminology described in [i2nsf-nsf-cap-im][RFC8431][supa-policy-info-model]. Especially, the following terms are from [supa-policy-info-model]:

- Data Model: A data model is a representation of concepts of interest to an environment in a form that is dependent on data repository, data definition language, query language, implementation language, and protocol.

- Information Model: An information model is a representation of concepts of interest to an environment in a form that is independent of data repository, data definition language, query language, implementation language, and protocol.

3.1. Tree Diagrams

A simplified graphical representation of the data model is used in this document. The meaning of the symbols in these diagrams [RFC8340] is as follows:

- Brackets "[" and "]" enclose list keys.
4. YANG Tree Diagram

This section shows an YANG tree diagram of generic network security functions. Note that a detailed data model for the configuration of the advanced network security functions is described in [i2nsf-advanced-nsf-dm]. The section describes the following subjects:

- General I2NSF security policy rule of generic network security function.
- An event clause of generic network security function.
- A condition clause of generic network security function.
- An action clause of generic network security function.


This section shows YANG tree diagram for general I2NSF security policy rule.
module: ietf-i2nsf-policy-rule-for-nsf
  +--rw i2nsf-security-policy
  +--rw system-policy* [system-policy-name]
    +--rw system-policy-name string
    +--rw priority-usage? identityref
    +--rw resolution-strategy? identityref
    +--rw default-action? identityref
    +--rw rules* [rule-name]
      +--rw rule-name string
      +--rw rule-description? string
      +--rw rule-priority? uint8
      +--rw rule-enable? boolean
      +--rw time-zone
        +--rw absolute-time-zone
          +--rw start-time? start-time-type
          +--rw end-time? end-time-type
        +--rw periodic-time-zone
          +--rw day
            +--rw every-day? boolean
            +--rw specific-day* day-type
          +--rw month
            +--rw every-month? boolean
            +--rw specific-month* month-type
        +--rw event-clause-container
          ...
    +--rw condition-clause-container
      ...
    +--rw action-clause-container
      ...

Figure 1: YANG Tree Diagram for Network Security Policy

This YANG tree diagram shows general I2NSF security policy rule for generic network security functions.

The system policy represents there could be multiple system policies in one NSF, and each system policy is used by one virtual instance of the NSF/device. The system policy includes system policy name, priority usage, resolution strategy, default action, and rules.

A resolution strategy is used to decide how to resolve conflicts that occur between the actions of the same or different policy rules that are matched and contained in this particular NSF. The resolution strategy is defined as First Matching Rule (FMR), Last Matching Rule (LMR), Prioritized Matching Rule (PMR) with Errors (PMRE), and Prioritized Matching Rule with No Errors (PMRN). The resolution strategy can be extended according to specific vendor action.
features. The resolution strategy is described in detail in [i2nsf-nsf-cap-im].

A default action is used to execute I2NSF policy rule when no rule matches a packet. The default action is defined as pass, drop, reject, alert, and mirror. The default action can be extended according to specific vendor action features. The default action is described in detail in [i2nsf-nsf-cap-im].

The rules include rule name, rule description, rule priority, rule enable, time zone, event clause container, condition clause container, and action clause container.

4.2. Event Clause

This section shows YANG tree diagram for an event clause of I2NSF security policy rule.

```yang
module: ietf-i2nsf-policy-rule-for-nsf
  +--rw i2nsf-security-policy
    +--rw system-policy* [system-policy-name]
      ...
      +--rw rules* [rule-name]
        ...
        +--rw event-clause-container
          | +--rw event-clause-description? string
          | +--rw event-clauses
          |   +--rw system-event* identityref
          |   +--rw system-alarm* identityref
          +--rw condition-clause-container
            ...
          +--rw action-clause-container
            ...
```

Figure 2: YANG Tree Diagram for Network Security Policy

This YANG tree diagram shows an event clause of I2NSF security policy rule for generic network security functions. An event clause is any important occurrence in time of a change in the system being managed, and/or in the environment of the system being managed. An event clause is used to trigger the evaluation of the condition clause of the I2NSF Policy Rule. The event clause is defined as system event and system alarm. The event clause can be extended according to specific vendor event features. The event clause is described in detail in [i2nsf-nsf-cap-im].
4.3. Condition Clause

This section shows YANG tree diagram for a condition clause of I2NSF security policy rule.

module: ietf-i2nsf-policy-rule-for-nsf
  +--rw i2nsf-security-policy
     ...
     +--rw rules* [rule-name]
        ...
        +--rw event-clause-container
        |   ...
        +--rw condition-clause-container
           +--rw condition-clause-description? string
           +--rw packet-security-ipv4-condition
              +--rw pkt-sec-ipv4-header-length
                 +--rw (match-type)?
                    +--:(exact-match)
                    |   +--rw ipv4-header-length* uint8
                    +--:(range-match)
                       +--rw range-ipv4-header-length* [start-ipv4-header-length end-ipv4-header-length]
                       +--rw start-ipv4-header-length uint8
                       +--rw end-ipv4-header-length uint8
           +--rw pkt-sec-ipv4-tos* identityref
           +--rw pkt-sec-ipv4-total-length
              +--rw (match-type)?
                 +--:(exact-match)
                 |   +--rw ipv4-total-length* uint16
                 +--:(range-match)
                    +--rw range-ipv4-total-length* [start-ipv4-total-length end-ipv4-total-length]
                    +--rw start-ipv4-total-length uint16
                    +--rw end-ipv4-total-length uint16
           +--rw pkt-sec-ipv4-id* uint16
           +--rw pkt-sec-ipv4-fragment-flags* identityref
           +--rw pkt-sec-ipv4-fragment-offset
              +--rw (match-type)?
                 +--:(exact-match)
                 |   +--rw ipv4-fragment-offset* uint16
                 +--:(range-match)
                    +--rw range-ipv4-fragment-offset* [start-ipv4-fragment-offset end-ipv4-fragment-offset]
                    +--rw start-ipv4-fragment-offset uint16
                    +--rw end-ipv4-fragment-offset uint16
           +--rw pkt-sec-ipv4-ttl
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| +--rw ipv4-ttl*         uint8            | +--:(range-match) |
| +--rw range-ipv4-ttl*    | +--rw start-ipv4-ttl uint8 |
|[start-ipv4-ttl end-ipv4-ttl] | +--rw end-ipv4-ttl uint8 |
| +--rw pkt-sec-ipv4-protocol* identityref |
| +--rw pkt-sec-ipv4-src |
| +--rw (match-type)?      | +--:(exact-match) |
| | +--rw start-ipv4-ttl uint8 |
| +--rw range-ipv4-ttl*    | +--:(range-match) |
|[start-ipv4-ttl end-ipv4-ttl] | +--rw range-ipv4-address* |
| +--rw pkt-sec-ipv4-source inet:ipv4-address |
| +--:(subnet)?            | +--rw prefix-length? uint8 |
| | +--:(prefix-length)     | +--:(netmask) |
| | +--rw prefix-length? uint8 |
| | +--:(netmask)           | +--rw netmask? yang:dotted-quad |
| | +--:(range-match)       | +--rw range-ipv4-address* |
|[start-ipv4-address end-ipv4-address] | +--rw start-ipv4-address inet:ipv4-address |
| +--rw end-ipv4-address inet:ipv4-address |
| +--rw pkt-sec-ipv4-dest | +--rw (match-type)? |
| +--:(exact-match)        | +--rw start-ipv4-address inet:ipv4-address |
| | +--rw ipv4             inet:ipv4-address |
| | +--:(subnet)?          | +--rw prefix-length? uint8 |
| | | +--rw prefix-length? uint8 |
| | | +--:(netmask)         | +--rw netmask? yang:dotted-quad |
| | | +--:(range-match)     | +--rw range-ipv4-address* |
|[start-ipv4-address end-ipv4-address] | +--rw start-ipv4-address inet:ipv4-address |
| +--rw end-ipv4-address inet:ipv4-address |
| +--rw pkt-sec-ipv4-opts* identityref |
| +--rw pkt-sec-ipv4-sameip? boolean |
| +--rw pkt-sec-ipv4-geoip* string |
| +--rw packet-security-ipv6-condition identityref |
| +--rw pkt-sec-ipv6-traffic-class* identityref |
| +--rw pkt-sec-ipv6-flow-label* uint32 |
| +--:(range-match)        | +--rw ipv6-flow-label* uint32 |
| +--:(range-match)        | +--rw ipv6-flow-label* uint32 |

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---rw range-ipv6-flow-label*
[start-ipv6-flow-label end-ipv6-flow-label]
  ++-rw start-ipv6-flow-label    uint32
  ++-rw end-ipv6-flow-label     uint32
++-rw pkt-sec-ipv6-payload-length
  ++-rw (match-type)?
   ++-:(exact-match)
    |  ++-rw ipv6-payload-length*     uint16
   ++-:(range-match)
    ++-rw range-ipv6-payload-length*
[start-ipv6-payload-length end-ipv6-payload-length]
  ++-rw start-ipv6-payload-length    uint16
  ++-rw end-ipv6-payload-length   uint16
++-rw pkt-sec-ipv6-next-header*  identityref
++-rw pkt-sec-ipv6-hop-limit
  ++-rw (match-type)?
   ++-:(exact-match)
    |  ++-rw ipv6-hop-limit*           uint8
   ++-:(range-match)
    ++-rw range-ipv6-hop-limit*
[start-ipv6-hop-limit end-ipv6-hop-limit]
  ++-rw start-ipv6-hop-limit     uint8
  ++-rw end-ipv6-hop-limit      uint8
++-rw pkt-sec-ipv6-src
  ++-rw (match-type)?
   ++-:(exact-match)
    |  ++-rw ipv6
     ++-rw ipv6-address*  [ipv6]
      ++-rw ipv6           inet:ipv6-address
     ++-rw prefix-length?  uint8
   ++-:(range-match)
    ++-rw range-ipv6-address*
[start-ipv6-address end-ipv6-address]
  ++-rw start-ipv6-address       inet:ipv6-address
  ++-rw end-ipv6-address        inet:ipv6-address
++-rw pkt-sec-ipv6-dest
  ++-rw (match-type)?
   ++-:(exact-match)
    |  ++-rw ipv6-address*  [ipv6]
     ++-rw ipv6           inet:ipv6-address
     ++-rw prefix-length?  uint8
   ++-:(range-match)
    ++-rw range-ipv6-address*
[start-ipv6-address end-ipv6-address]
  ++-rw start-ipv6-address       inet:ipv6-address
  ++-rw end-ipv6-address        inet:ipv6-address
++-rw packet-security-tcp-condition
  ++-rw pkt-sec-tcp-src-port-num

---rw (match-type)?
  +---: (exact-match)
    |  +---rw port-num*                 inet:port-number
    +---: (range-match)
      +---rw range-port-num*
        [start-port-num end-port-num]
          +---rw start-port-num         inet:port-number
          +---rw end-port-num           inet:port-number
      +---rw pkt-sec-tcp-dest-port-num
        +---rw (match-type)?
          +---: (exact-match)
            |  +---rw port-num*             inet:port-number
            +---: (range-match)
              +---rw range-port-num*
        [start-port-num end-port-num]
          +---rw start-port-num         inet:port-number
          +---rw end-port-num           inet:port-number
        +---rw pkt-sec-tcp-seq-num
          +---rw (match-type)?
            +---: (exact-match)
              |  +---rw tcp-seq-num*          uint32
              +---: (range-match)
                +---rw range-tcp-seq-num*
        [start-tcp-seq-num end-tcp-seq-num]
          +---rw start-tcp-seq-num        uint32
          +---rw end-tcp-seq-num          uint32
        +---rw pkt-sec-tcp-ack-num
          +---rw (match-type)?
            +---: (exact-match)
              |  +---rw tcp-ack-num*          uint32
              +---: (range-match)
                +---rw range-tcp-ack-num*
        [start-tcp-ack-num end-tcp-ack-num]
          +---rw start-tcp-ack-num        uint32
          +---rw end-tcp-ack-num          uint32
        +---rw pkt-sec-tcp-window-size
          +---rw (match-type)?
            +---: (exact-match)
              |  +---rw tcp-window-size*       uint16
              +---: (range-match)
                +---rw range-tcp-window-size*
        [start-tcp-window-size end-tcp-window-size]
          +---rw start-tcp-window-size     uint16
          +---rw end-tcp-window-size       uint16
        +---rw pkt-sec-tcp-flags*        identityref
        +---rw packet-security-udp-condition
          +---rw pkt-sec-udp-src-port-num
            +---rw (match-type)?
This YANG tree diagram shows an condition clause of I2NSF security policy rule for generic network security functions. A condition clause is defined as a set of attributes, features, and/or values that are to be compared with a set of known attributes, features, and/or values in order to determine whether or not the set of actions in that (imperative) I2NSF policy rule can be executed or not. The
condition clause is classified as conditions of generic network security functions and advanced network security functions. The condition clause of generic network security functions is defined as packet security IPv4 condition, packet security IPv6 condition, packet security tcp condition, and packet security icmp condition. The condition clause of advanced network security functions is defined as packet security http condition, packet security voice condition, and packet security ddos condition. Note that this document deals only with simple conditions of advanced network security functions. The condition clauses of advanced network security functions are described in detail in [i2nsf-advanced-nsf-dm]. The condition clause can be extended according to specific vendor condition features. The condition clause is described in detail in [i2nsf-nsf-cap-im].

4.4. Action Clause

This section shows YANG tree diagram for an action clause of I2NSF security policy rule.

```yang
module: ietf-i2nsf-policy-rule-for-nsf
  +--rw i2nsf-security-policy
    ...                   +--rw rules* [rule-name]
    ...                   +--rw event-clause-container
     |                       +--rw condition-clause-container
     |                       +--rw action-clause-container
     |     +--rw action-clause-description?  string
     |     +--rw packet-action
     |       +--rw ingress-action?          identityref
     |       +--rw egress-action?           identityref
     |       +--rw log-action?             identityref
     +--rw advanced-action
       +--rw content-security-control*    identityref
       +--rw attack-mitigation-control*   identityref
```

Figure 4: YANG Tree Diagram for Network Security Policy

This YANG tree diagram shows an action clause of I2NSF security policy rule for generic network security functions. An action is used to control and monitor aspects of flow-based NSFs when the event and condition clauses are satisfied. NSFs provide security services by executing various actions. The action clause is defined as ingress action, egress action, log action, and advanced action for...
additional inspection. The advanced action is described in detail in [RFC8329] and [i2nsf-nsf-cap-im]. The action clause can be extended according to specific vendor action features. The action clause is described in detail in [i2nsf-nsf-cap-im].

5. YANG Data Module

5.1. I2NSF NSF-Facing Interface YANG Data Module

This section introduces an YANG data module for configuration of security policy rules on network security functions.

<CODE BEGINS> file "ietf-i2nsf-policy-rule-for-nsf@2019-03-11.yang"

module ietf-i2nsf-policy-rule-for-nsf {
  yang-version 1.1;
  prefix iiprfn;

  import ietf-inet-types{
    prefix inet;
    reference "RFC 6991";
  }

  import ietf-yang-types{
    prefix yang;
    reference "RFC 6991";
  }

  organization "IETF I2NSF (Interface to Network Security Functions) Working Group";

  contact "WG Web: <http://tools.ietf.org/wg/i2nsf>
  WG List: <mailto:i2nsf@ietf.org>
  WG Chair: Adrian Farrel <mailto:Adrain@olddog.co.uk>
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  Editor: Jaehoon Paul Jeong"
This module defines a YANG data module for network security functions.

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This version of this YANG module is part of RFC 8341; see the RFC itself for full legal notices.

revision "2019-03-11"{
  description "Initial revision.";
  reference
    "RFC XXXX: I2NSF Network Security Function-Facing Interface YANG Data Model";
}

/*
 * Identities
 */

identity priority-usage-type {
  description
    "Base identity for priority usage type.";
}

identity priority-by-order {
  base priority-usage-type;
  description
    "Identity for priority by order";
}

identity priority-by-number {
  base priority-usage-type;
  description
    "Identity for priority by number";
}
"Identity for priority by number";
}

identity event {
    description
        "Base identity for event of policy.";
    reference
        "draft-hong-i2nsf-nsf-monitoring-data-model-06
          - Event";
}

identity system-event {
    base event;
    description
        "Identity for system event";
    reference
        "draft-hong-i2nsf-nsf-monitoring-data-model-06
          - System event";
}

identity system-alarm {
    base event;
    description
        "Identity for system alarm";
    reference
        "draft-hong-i2nsf-nsf-monitoring-data-model-06
          - System alarm";
}

identity access-violation {
    base system-event;
    description
        "Identity for access violation among system events";
    reference
        "draft-hong-i2nsf-nsf-monitoring-data-model-06
          - System event";
}

identity configuration-change {
    base system-event;
    description
        "Identity for configuration change among system events";
    reference
        "draft-hong-i2nsf-nsf-monitoring-data-model-06
          - System event";
}
identity memory-alarm {
    base system-alarm;
    description "Identity for memory alarm among system alarms";
}

identity cpu-alarm {
    base system-alarm;
    description "Identity for cpu alarm among system alarms";
}

identity disk-alarm {
    base system-alarm;
    description "Identity for disk alarm among system alarms";
}

identity hardware-alarm {
    base system-alarm;
    description "Identity for hardware alarm among system alarms";
}

identity interface-alarm {
    base system-alarm;
    description "Identity for interface alarm among system alarms";
}
identity type-of-service {
  description
    "Base identity for type of service of IPv4";
  reference
    "RFC 791: Internet Protocol - Type of Service";
}

identity traffic-class {
  description
    "Base identity for traffic-class of IPv6";
  reference
}

identity normal {
  base type-of-service;
  base traffic-class;
  description
    "Identity for normal";
  reference
    "RFC 791: Internet Protocol - Type of Service
}

identity minimize-cost {
  base type-of-service;
  base traffic-class;
  description
    "Identity for minimize cost";
  reference
    "RFC 791: Internet Protocol - Type of Service
}

identity maximize-reliability {
  base type-of-service;
  base traffic-class;
  description
    "Identity for maximize reliability";
  reference
    "RFC 791: Internet Protocol - Type of Service
}
identity maximize-throughput {
    base type-of-service;
    base traffic-class;
    description
        "Identity for maximize throughput";
    reference
        "RFC 791: Internet Protocol - Type of Service
        RFC 2460: Internet Protocol, Version 6 (IPv6)
        Specification - Traffic Class";
}

identity minimize-delay {
    base type-of-service;
    base traffic-class;
    description
        "Identity for minimize delay";
    reference
        "RFC 791: Internet Protocol - Type of Service
        RFC 2460: Internet Protocol, Version 6 (IPv6)
        Specification - Traffic Class";
}

identity maximize-security {
    base type-of-service;
    base traffic-class;
    description
        "Identity for maximize security";
    reference
        "RFC 791: Internet Protocol - Type of Service
        RFC 2460: Internet Protocol, Version 6 (IPv6)
        Specification - Traffic Class";
}

identity fragmentation-flags-type {
    description
        "Base identity for fragmentation flags type";
    reference
        "RFC 791: Internet Protocol - Fragmentation Flags";
}

identity fragment {
    base fragmentation-flags-type;
    description
        "Identity for fragment";
    reference
        "RFC 791: Internet Protocol - Fragmentation Flags";
identity no-fragment {
    base fragmentation-flags-type;
    description "Identity for no fragment";
    reference
        "RFC 791: Internet Protocol - Fragmentation Flags";
}

identity reserved {
    base fragmentation-flags-type;
    description "Identity for reserved";
    reference
        "RFC 791: Internet Protocol - Fragmentation Flags";
}

identity protocol {
    description "Base identity for protocol of IPv4";
    reference
        "RFC 790: Assigned numbers - Assigned Internet Protocol Number"
        "RFC 791: Internet Protocol - Protocol";
}

identity next-header {
    description "Base identity for next header of IPv6";
    reference
        "RFC 2460: Internet Protocol, Version 6 (IPv6)
        Specification - Next Header";
}

identity icmp {
    base protocol;
    base next-header;
    description "Identity for icmp";
    reference
        "RFC 790: - Assigned numbers - Assigned Internet Protocol Number"
        "RFC 791: Internet Protocol - Type of Service"
        "RFC 2460: Internet Protocol, Version 6 (IPv6)
        Specification - Next Header";
}
identity igmp {
    base protocol;
    base next-header;
    description "Identity for igmp";
    reference
        "RFC 790: - Assigned numbers - Assigned Internet Protocol Number"
        "RFC 791: Internet Protocol - Type of Service"
}

identity tcp {
    base protocol;
    base next-header;
    description "Identity for tcp";
    reference
        "RFC 790: - Assigned numbers - Assigned Internet Protocol Number"
        "RFC 791: Internet Protocol - Type of Service"
}

identity igrp {
    base protocol;
    base next-header;
    description "Identity for igrp";
    reference
        "RFC 790: - Assigned numbers - Assigned Internet Protocol Number"
        "RFC 791: Internet Protocol - Type of Service"
}

identity udp {
    base protocol;
    base next-header;
    description "Identity for udp";
    reference
        "RFC 790: - Assigned numbers - Assigned Internet Protocol Number"
        "RFC 791: Internet Protocol - Type of Service"
RFC 2460: Internet Protocol, Version 6 (IPv6)
Specification - Next Header";
}

identity gre {
  base protocol;
  base next-header;
  description
    "Identity for gre";
  reference
    "RFC 790: - Assigned numbers - Assigned Internet Protocol Number
RFC 791: Internet Protocol - Type of Service
RFC 2460: Internet Protocol, Version 6 (IPv6)
Specification - Next Header";
}

identity esp {
  base protocol;
  base next-header;
  description
    "Identity for esp";
  reference
    "RFC 790: - Assigned numbers - Assigned Internet Protocol Number
RFC 791: Internet Protocol - Type of Service
RFC 2460: Internet Protocol, Version 6 (IPv6)
Specification - Next Header";
}

identity ah {
  base protocol;
  base next-header;
  description
    "Identity for ah";
  reference
    "RFC 790: - Assigned numbers - Assigned Internet Protocol Number
RFC 791: Internet Protocol - Type of Service
RFC 2460: Internet Protocol, Version 6 (IPv6)
Specification - Next Header";
}

identity mobile {
  base protocol;
  base next-header;
  description
    "Identity for mobile";
reference
"RFC 790: - Assigned numbers - Assigned Internet
   Protocol Number
RFC 791: Internet Protocol - Type of Service
RFC 2460: Internet Protocol, Version 6 (IPv6)
   Specification - Next Header";
}

identity tlsp {
   base protocol;
   base next-header;
   description
      "Identity for tlsp";
   reference
      "RFC 790: - Assigned numbers - Assigned Internet
         Protocol Number
RFC 791: Internet Protocol - Type of Service
RFC 2460: Internet Protocol, Version 6 (IPv6)
   Specification - Next Header";
}

identity skip {
   base protocol;
   base next-header;
   description
      "Identity for skip";
   reference
      "RFC 790: - Assigned numbers - Assigned Internet
         Protocol Number
RFC 791: Internet Protocol - Type of Service
RFC 2460: Internet Protocol, Version 6 (IPv6)
   Specification - Next Header";
}

identity ipv6-icmp {
   base protocol;
   base next-header;
   description
      "Identity for IPv6 icmp ";
   reference
      "RFC 790: - Assigned numbers - Assigned Internet
         Protocol Number
RFC 791: Internet Protocol - Type of Service
RFC 2460: Internet Protocol, Version 6 (IPv6)
   Specification - Next Header";
}
identity eigrp {
    base protocol;
    base next-header;
    description
        "Identity for eigrp";
    reference
        "RFC 790: - Assigned numbers - Assigned Internet
        Protocol Number
        RFC 791: Internet Protocol - Type of Service
        RFC 2460: Internet Protocol, Version 6 (IPv6)
        Specification - Next Header";
}

identity ospf {
    base protocol;
    base next-header;
    description
        "Identity for ospf";
    reference
        "RFC 790: - Assigned numbers - Assigned Internet
        Protocol Number
        RFC 791: Internet Protocol - Type of Service
        RFC 2460: Internet Protocol, Version 6 (IPv6)
        Specification - Next Header";
}

identity l2tp {
    base protocol;
    base next-header;
    description
        "Identity for l2tp";
    reference
        "RFC 790: - Assigned numbers - Assigned Internet
        Protocol Number
        RFC 791: Internet Protocol - Type of Service
        RFC 2460: Internet Protocol, Version 6 (IPv6)
        Specification - Next Header";
}

identity ipopts {
    description
        "Base identity for IP options";
    reference
        "RFC 791: Internet Protocol - Options";
}

identity rr {
base ipopts;
description
   "Identity for record route";
reference
   "RFC 791: Internet Protocol - Options";
}

identity eol {
    base ipopts;
    description
       "Identity for end of list";
    reference
       "RFC 791: Internet Protocol - Options";
}

identity nop {
    base ipopts;
    description
       "Identity for no operation";
    reference
       "RFC 791: Internet Protocol - Options";
}

identity ts {
    base ipopts;
    description
       "Identity for time stamp";
    reference
       "RFC 791: Internet Protocol - Options";
}

identity sec {
    base ipopts;
    description
       "Identity for IP security";
    reference
       "RFC 791: Internet Protocol - Options";
}

identity esec {
    base ipopts;
    description
       "Identity for IP extended security";
    reference
       "RFC 791: Internet Protocol - Options";
}

identity lsrr {

base ipopts;

description
   "Identity for loose source routing";
reference
   "RFC 791: Internet Protocol - Options";
}

identity ssrr {
    base ipopts;
    description
       "Identity for strict source routing";
    reference
       "RFC 791: Internet Protocol - Options";
}

identity satid {
    base ipopts;
    description
       "Identity for stream identifier";
    reference
       "RFC 791: Internet Protocol - Options";
}

identity any {
    base ipopts;
    description
       "Identity for which any IP options are set";
    reference
       "RFC 791: Internet Protocol - Options";
}

identity tcp-flags {
    description
       "Base identity for tcp flags";
    reference
       "RFC 793: Transmission Control Protocol - Flags";
}

identity cwr {
    base tcp-flags;
    description
       "Identity for congestion window reduced";
    reference
       "RFC 793: Transmission Control Protocol - Flags";
}

identity ecn {
    base tcp-flags;
}
description
  "Identity for explicit congestion notification";
reference
  "RFC 793: Transmission Control Protocol - Flags";
}

identity urg {
  base tcp-flags;
  description
    "Identity for urgent";
  reference
    "RFC 793: Transmission Control Protocol - Flags";
}

identity ack {
  base tcp-flags;
  description
    "Identity for acknowledgement";
  reference
    "RFC 793: Transmission Control Protocol - Flags";
}

identity psh {
  base tcp-flags;
  description
    "Identity for push";
  reference
    "RFC 793: Transmission Control Protocol - Flags";
}

identity rst {
  base tcp-flags;
  description
    "Identity for reset";
  reference
    "RFC 793: Transmission Control Protocol - Flags";
}

identity syn {
  base tcp-flags;
  description
    "Identity for synchronize";
  reference
    "RFC 793: Transmission Control Protocol - Flags";
}

identity fin {
  base tcp-flags;
}
description
  "Identity for finish";
reference
  "RFC 793: Transmission Control Protocol - Flags";
}

identity icmp-type {
  description
    "Base identity for icmp types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity echo-reply {
  base icmp-type;
  description
    "Identity for echo reply";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity destination-unreachable {
  base icmp-type;
  description
    "Identity for destination unreachable";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity source-quench {
  base icmp-type;
  description
    "Identity for source quench";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity redirect {
  base icmp-type;
  description
    "Identity for redirect";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity alternate-host-address {
  base icmp-type;
  description

"Identity for alternate host address";
reference
"RFC 792: Internet Control Message Protocol";
}

identity echo {
  base icmp-type;
  description
    "Identity for echo";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity router-advertisement {
  base icmp-type;
  description
    "Identity for router advertisement";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity router-solicitation {
  base icmp-type;
  description
    "Identity for router solicitation";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity time-exceeded {
  base icmp-type;
  description
    "Identity for time exceeded";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity parameter-problem {
  base icmp-type;
  description
    "Identity for parameter problem";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity timestamp {
  base icmp-type;
  description

"Identity for timestamp"
reference
"RFC 792: Internet Control Message Protocol"
}

identity timestamp-reply {
  base icmp-type;
  description
  "Identity for timestamp reply"
  reference
  "RFC 792: Internet Control Message Protocol"
}

identity information-request {
  base icmp-type;
  description
  "Identity for information request"
  reference
  "RFC 792: Internet Control Message Protocol"
}

identity information-reply {
  base icmp-type;
  description
  "Identity for information reply"
  reference
  "RFC 792: Internet Control Message Protocol"
}

identity address-mask-request {
  base icmp-type;
  description
  "Identity for address mask request"
  reference
  "RFC 792: Internet Control Message Protocol"
}

identity address-mask-reply {
  base icmp-type;
  description
  "Identity for address mask reply"
  reference
  "RFC 792: Internet Control Message Protocol"
}

identity traceroute {
  base icmp-type;
  description

Kim, et al.  Expires September 12, 2019
"Identity for traceroute";
reference
 "RFC 792: Internet Control Message Protocol";
}

identity datagram-conversion-error {
  base icmp-type;
  description
   "Identity for datagram conversion error";
  reference
   "RFC 792: Internet Control Message Protocol";
}

identity mobile-host-redirect {
  base icmp-type;
  description
   "Identity for mobile host redirect";
  reference
   "RFC 792: Internet Control Message Protocol";
}

identity ipv6-where-are-you {
  base icmp-type;
  description
   "Identity for IPv6 where are you";
  reference
   "RFC 792: Internet Control Message Protocol";
}

identity ipv6-i-am-here {
  base icmp-type;
  description
   "Identity for IPv6 i am here";
  reference
   "RFC 792: Internet Control Message Protocol";
}

identity mobile-registration-request {
  base icmp-type;
  description
   "Identity for mobile registration request";
  reference
   "RFC 792: Internet Control Message Protocol";
}

identity mobile-registration-reply {
  base icmp-type;
  description

"Identity for mobile registration reply";
reference
"RFC 792: Internet Control Message Protocol";
}

identity domain-name-request {
  base icmp-type;
  description
    "Identity for domain name request";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity domain-name-reply {
  base icmp-type;
  description
    "Identity for domain name reply";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity iskip {
  base icmp-type;
  description
    "Identity for icmp skip";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity photuris {
  base icmp-type;
  description
    "Identity for photuris";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity experimental-mobility-protocols {
  base icmp-type;
  description
    "Identity for experimental mobility protocols";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity extended-echo-request {
  base icmp-type;
  description

"Identity for extended echo request";
reference
"RFC 792: Internet Control Message Protocol
RFC 8335: PROBE: A Utility for Probing Interfaces";
}

identity extended-echo-reply {
  base icmp-type;
  description
    "Identity for extended echo reply";
  reference
    "RFC 792: Internet Control Message Protocol
    RFC 8335: PROBE: A Utility for Probing Interfaces";
}

identity net-unreachable {
  base icmp-type;
  description
    "Identity for net unreachable
    in destination unreachable types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity host-unreachable {
  base icmp-type;
  description
    "Identity for host unreachable
    in destination unreachable types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity protocol-unreachable {
  base icmp-type;
  description
    "Identity for protocol unreachable
    in destination unreachable types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity port-unreachable {
  base icmp-type;
  description
    "Identity for port unreachable
    in destination unreachable types";
  reference

"RFC 792: Internet Control Message Protocol";
}

identity fragment-set {
    base icmp-type;
    description
        "Identity for fragmentation set
         in destination unreachable types";
    reference
        "RFC 792: Internet Control Message Protocol";
}

identity source-route-failed {
    base icmp-type;
    description
        "Identity for source route failed
         in destination unreachable types";
    reference
        "RFC 792: Internet Control Message Protocol";
}

identity destination-network-unknown {
    base icmp-type;
    description
        "Identity for destination network unknown
         in destination unreachable types";
    reference
        "RFC 792: Internet Control Message Protocol";
}

identity destination-host-unknown {
    base icmp-type;
    description
        "Identity for destination host unknown
         in destination unreachable types";
    reference
        "RFC 792: Internet Control Message Protocol";
}

identity source-host-isolated {
    base icmp-type;
    description
        "Identity for source host isolated
         in destination unreachable types";
    reference
        "RFC 792: Internet Control Message Protocol";
}
identity communication-prohibited-with-destination-network {
  base icmp-type;
  description
    "Identity for which communication with destination network
    is administratively prohibited in destination unreachable
    types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity communication-prohibited-with-destination-host {
  base icmp-type;
  description
    "Identity for which communication with destination host
    is administratively prohibited in destination unreachable
    types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity destination-network-unreachable-for-tos {
  base icmp-type;
  description
    "Identity for destination network unreachable
    for type of service in destination unreachable types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity destination-host-unreachable-for-tos {
  base icmp-type;
  description
    "Identity for destination host unreachable
    for type of service in destination unreachable types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity communication-prohibited {
  base icmp-type;
  description
    "Identity for communication administratively prohibited
    in destination unreachable types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity host-precedence-violation {
base icmp-type;
description
  "Identity for host precedence violation in destination unreachable types";
reference
  "RFC 792: Internet Control Message Protocol";
}

identity precedence-cutoff-in-effect {
  base icmp-type;
  description
    "Identity for precedence cutoff in effect in destination unreachable types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity redirect-datagram-for-the-network {
  base icmp-type;
  description
    "Identity for redirect datagram for the network (or subnet) in redirect types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity redirect-datagram-for-the-host {
  base icmp-type;
  description
    "Identity for redirect datagram for the host in redirect types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity redirect-datagram-for-the-tos-and-network {
  base icmp-type;
  description
    "Identity for redirect datagram for the type of service and network in redirect types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity redirect-datagram-for-the-tos-and-host {
  base icmp-type;
  description
    "Identity for redirect datagram for the type of
service and host in redirect types";
reference
"RFC 792: Internet Control Message Protocol";
}

identity normal-router-advertisement {
  base icmp-type;
  description
  "Identity for normal router advertisement in router advertisement types";
  reference
  "RFC 792: Internet Control Message Protocol";
}

identity does-not-route-common-traffic {
  base icmp-type;
  description
  "Identity for does not route common traffic in router advertisement types";
  reference
  "RFC 792: Internet Control Message Protocol";
}

identity time-to-live-exceeded-in-transit {
  base icmp-type;
  description
  "Identity for time to live exceeded in transit in time exceeded types";
  reference
  "RFC 792: Internet Control Message Protocol";
}

identity fragment-reassembly-time-exceeded {
  base icmp-type;
  description
  "Identity for fragment reassembly time exceeded in time exceeded types";
  reference
  "RFC 792: Internet Control Message Protocol";
}

identity pointer-indicates-the-error {
  base icmp-type;
  description
  "Identity for pointer indicates the error in parameter problem types";
  reference
  "RFC 792: Internet Control Message Protocol";
}
identity missing-a-required-option {
    base icmp-type;
    description
        "Identity for missing a required option
        in parameter problem types";
    reference
        "RFC 792: Internet Control Message Protocol";
}

identity bad-length {
    base icmp-type;
    description
        "Identity for bad length
        in parameter problem types";
    reference
        "RFC 792: Internet Control Message Protocol";
}

identity bad-spi {
    base icmp-type;
    description
        "Identity for bad spi
        in photuris types";
    reference
        "RFC 792: Internet Control Message Protocol";
}

identity authentication-failed {
    base icmp-type;
    description
        "Identity for authentication failed
        in photuris types";
    reference
        "RFC 792: Internet Control Message Protocol";
}

identity decompression-failed {
    base icmp-type;
    description
        "Identity for decompression failed
        in photuris types";
    reference
        "RFC 792: Internet Control Message Protocol";
}

identity decryption-failed {

base icmp-type;
description
  "Identity for decryption failed
   in photuris types";
reference
  "RFC 792: Internet Control Message Protocol";
}

identity need-authentication {
  base icmp-type;
  description
    "Identity for need authentication
     in photuris types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity need-authorization {
  base icmp-type;
  description
    "Identity for need authorization
     in photuris types";
  reference
    "RFC 792: Internet Control Message Protocol";
}

identity req-no-error {
  base icmp-type;
  description
    "Identity for request with no error
     in extended echo request types";
  reference
    "RFC 792: Internet Control Message Protocol
     RFC 8335: PROBE: A Utility for Probing Interfaces";
}

identity rep-no-error {
  base icmp-type;
  description
    "Identity for reply with no error
     in extended echo reply types";
  reference
    "RFC 792: Internet Control Message Protocol
     RFC 8335: PROBE: A Utility for Probing Interfaces";
}

identity malformed-query {
  base icmp-type;
}
description
"Identity for malformed query
in extended echo reply types";
reference
"RFC 792: Internet Control Message Protocol
RFC 8335: PROBE: A Utility for Probing Interfaces";
}

identity no-such-interface {
base icmp-type;
description
"Identity for no such interface
in extended echo reply types";
reference
"RFC 792: Internet Control Message Protocol
RFC 8335: PROBE: A Utility for Probing Interfaces";
}

identity no-such-table-entry {
base icmp-type;
description
"Identity for no such table entry
in extended echo reply types";
reference
"RFC 792: Internet Control Message Protocol
RFC 8335: PROBE: A Utility for Probing Interfaces";
}

identity multiple-interfaces-satisfy-query {
base icmp-type;
description
"Identity for multiple interfaces satisfy query
in extended echo reply types";
reference
"RFC 792: Internet Control Message Protocol
RFC 8335: PROBE: A Utility for Probing Interfaces";
}

identity content-security-control {

description
"Base identity for content security control";
reference
"RFC 8329: Framework for Interface to
Network Security Functions - Differences
from ACL Data Models
draft-ietf-i2nsf-capability-04: Information Model
of NSF's Capabilities";
}
identity antivirus {
  base content-security-control;
  description
    "Identity for antivirus";
}

identity ips {
  base content-security-control;
  description
    "Identity for ips";
}

identity ids {
  base content-security-control;
  description
    "Identity for ids";
}

identity url-filtering {
  base content-security-control;
  description
    "Identity for url filtering";
}

identity mail-filtering {
  base content-security-control;
  description
    "Identity for mail filtering";
}

identity file-blocking {
  base content-security-control;
  description
    "Identity for file blocking";
}

identity file-isolate {
  base content-security-control;
  description
    "Identity for file isolate";
}

identity pkt-capture {
  base content-security-control;
  description
    "Identity for packet capture";
}
identity application-control {
    base content-security-control;
    description
        "Identity for application control";
}

identity voip-volte {
    base content-security-control;
    description
        "Identity for voip and volte";
}

identity attack-mitigation-control {
    description
        "Base identity for attack mitigation control";
    reference
        "RFC 8329: Framework for Interface to
         Network Security Functions - Differences
         from ACL Data Models
         draft-ietf-i2nsf-capability-04: Information Model
         of NSFs Capabilities";
}

identity syn-flood {
    base attack-mitigation-control;
    description
        "Identity for syn flood";
}

identity udp-flood {
    base attack-mitigation-control;
    description
        "Identity for udp flood";
}

identity icmp-flood {
    base attack-mitigation-control;
    description
        "Identity for icmp flood";
}

identity ip-frag-flood {
    base attack-mitigation-control;
    description
        "Identity for ip frag flood";
}

identity ipv6-related {

base attack-mitigation-control;
  description
    "Identity for ipv6 related";
}

identity http-and-https-flood {
  base attack-mitigation-control;
  description
    "Identity for http and https flood";
}

identity dns-flood {
  base attack-mitigation-control;
  description
    "Identity for dns flood";
}

identity dns-amp-flood {
  base attack-mitigation-control;
  description
    "Identity for dns amp flood";
}

identity ssl-ddos {
  base attack-mitigation-control;
  description
    "Identity for ssl ddos";
}

identity ip-sweep {
  base attack-mitigation-control;
  description
    "Identity for ip sweep";
}

identity port-scanning {
  base attack-mitigation-control;
  description
    "Identity for port scanning";
}

identity ping-of-death {
  base attack-mitigation-control;
  description
    "Identity for ping of death";
}

identity teardrop {
base attack-mitigation-control;
description "Identity for teardrop";
}

identity oversized-icmp {
    base attack-mitigation-control;
    description "Identity for oversized icmp"
}

identity tracert {
    base attack-mitigation-control;
    description "Identity for tracert"
}

identity ingress-action {
    description "Base identity for action";
    reference "draft-ietf-i2nsf-capability-04: Information Model of NSFs Capabilities - Ingress Action"
}

identity egress-action {
    description "Base identity for egress action";
    reference "draft-ietf-i2nsf-capability-04: Information Model of NSFs Capabilities - Egress action"
}

identity default-action {
    description "Base identity for default action";
    reference "draft-ietf-i2nsf-capability-04: Information Model of NSFs Capabilities - Default action"
}

identity pass {
    base ingress-action;
    base egress-action;
    base default-action;
    description "Identity for pass";
    reference
"draft-ietf-i2nsf-capability-04: Information Model of NSFs Capabilities - Actions and default action";

identity drop {
  base ingress-action;
  base egress-action;
  base default-action;
  description "Identity for drop";
  reference "draft-ietf-i2nsf-capability-04: Information Model of NSFs Capabilities - Actions and default action";
}

identity reject {
  base ingress-action;
  base egress-action;
  base default-action;
  description "Identity for reject";
  reference "draft-ietf-i2nsf-capability-04: Information Model of NSFs Capabilities - Actions and default action";
}

identity alert {
  base ingress-action;
  base egress-action;
  base default-action;
  description "Identity for alert";
  reference "draft-ietf-i2nsf-capability-04: Information Model of NSFs Capabilities - Actions and default action";
}

identity mirror {
  base ingress-action;
  base egress-action;
  base default-action;
  description "Identity for mirror";
  reference
"draft-ietf-i2nsf-capability-04: Information Model of NSFs Capabilities - Actions and default action";
}

identity log-action {
    description
        "Base identity for log action";
}

identity rule-log {
    base log-action;
    description
        "Identity for rule log";
}

identity session-log {
    base log-action;
    description
        "Identity for session log";
}

identity invoke-signaling {
    base egress-action;
    description
        "Identity for invoke signaling";
}

identity tunnel-encapsulation {
    base egress-action;
    description
        "Identity for tunnel encapsulation";
}

identity forwarding {
    base egress-action;
    description
        "Identity for forwarding";
}

identity redirection {
    base egress-action;
    description
        "Identity for redirection";
}

identity resolution-strategy {

description
  "Base identity for resolution strategy";
reference
  "draft-ietf-i2nsf-capability-04: Information Model
  of NSFs Capabilities - Resolution Strategy";
}

identity fmr {
  base resolution-strategy;
  description
    "Identity for First Matching Rule (FMR)";
  reference
    "draft-ietf-i2nsf-capability-04: Information Model
    of NSFs Capabilities - Resolution Strategy";
}

identity lmr {
  base resolution-strategy;
  description
    "Identity for Last Matching Rule (LMR)";
  reference
    "draft-ietf-i2nsf-capability-04: Information Model
    of NSFs Capabilities - Resolution Strategy";
}

identity pmr {
  base resolution-strategy;
  description
    "Identity for Prioritized Matching Rule (PMR)";
  reference
    "draft-ietf-i2nsf-capability-04: Information Model
    of NSFs Capabilities - Resolution Strategy";
}

identity pmre {
  base resolution-strategy;
  description
    "Identity for Prioritized Matching Rule
    with Errors (PMRE)";
  reference
    "draft-ietf-i2nsf-capability-04: Information Model
    of NSFs Capabilities - Resolution Strategy";
}

identity pmrn {
  base resolution-strategy;
  description
    "Identity for Prioritized Matching Rule
    with Errors (PMRE)";
  reference
    "draft-ietf-i2nsf-capability-04: Information Model
    of NSFs Capabilities - Resolution Strategy";
}
typedef start-time-type {
  type union {
    type string {
      pattern '\d{2}:\d{2}:\d{2}(\.\d+)?' + '(Z|\[\+-]\d{2}:\d{2})';
    }
  type enumeration {
    enum right-away {
      description "Immediate rule execution in the system.";
    }
  }
}
description "Start time when the rules are applied.";
}

typedef end-time-type {
  type union {
    type string {
      pattern '\d{2}:\d{2}:\d{2}(\.\d+)?' + '(Z|\[\+-]\d{2}:\d{2})';
    }
  type enumeration {
    enum infinitely {
      description "Infinite rule execution in the system.";
    }
  }
}
description "End time when the rules are applied.";
}
typedef day-type {
  type enumeration {
    enum sunday {
      description "Sunday for periodic day";
    }
    enum monday {
      description "Monday for periodic day";
    }
    enum tuesday {
      description "Tuesday for periodic day";
    }
    enum wednesday {
      description "Wednesday for periodic day";
    }
    enum thursday {
      description "Thursday for periodic day";
    }
    enum friday {
      description "Friday for periodic day";
    }
    enum saturday {
      description "Saturday for periodic day";
    }
  }
  description "This can be used for the rules to be applied according to periodic day";
}

typedef month-type {
  type enumeration {
    enum january {
      description "January for periodic month";
    }
    enum february {
      description "February for periodic month";
    }
    enum march {
      description
"March for periodic month";
}
enum april {
    description
    "April for periodic month";
}
enum may {
    description
    "May for periodic month";
}
enum june {
    description
    "June for periodic month";
}
enum july {
    description
    "July for periodic month";
}
enum august {
    description
    "August for periodic month";
}
enum september {
    description
    "September for periodic month";
}
enum october {
    description
    "October for periodic month";
}
enum november {
    description
    "November for periodic month";
}
enum december {
    description
    "December for periodic month";
}
}

description
"This can be used for the rules to be applied according to periodic month";
}

/*
 * Groupings
 */
grouping ipv4 {
  list ipv4-address {
    key "ipv4";
    description
      "The list of IPv4 address."
    leaf ipv4 {
      type inet:ipv4-address;
      description
        "The value of IPv4 address."
    }
    choice subnet {
      description
        "The subnet can be specified as a prefix length or netmask."
      leaf prefix-length {
        type uint8 {
          range "0..32";
        }
        description
          "The length of the subnet prefix."
      }
      leaf netmask {
        type yang:dotted-quad;
        description
          "The subnet specified as a netmask."
      }
    }
  }
  description
    "Grouping for an IPv4 address"
}

reference
  "RFC 791: Internet Protocol - IPv4 address"
  "RFC 8344: A YANG Data Model for IP Management"
}

grouping ipv6 {
  list ipv6-address {
    key "ipv6";
    description
      "The list of IPv6 address."
    leaf ipv6 {
      type inet:ipv6-address;
      description
        "The value of IPv6 address."
    }
  }
  description
    "Grouping for an IPv6 address"
}

leaf prefix-length {
    type uint8 {
        range "0..128";
    }
    description
        "The length of the subnet prefix.";
}

description
    "Grouping for an IPv6 address";

reference
    "RFC 2460: Internet Protocol, Version 6 (IPv6)
     Specification - IPv6 address
RFC 8344: A YANG Data Model for IP Management";

grouping pkt-sec-ipv4 {
    choice match-type {
        description
            "There are two types to configure a security policy
            for IPv4 address, such as exact match and range match.";
        case exact-match {
            uses ipv4;
            description
                "Exact match for an IPv4 address.";
        }
        case range-match {
            list range-ipv4-address {
                key "start-ipv4-address end-ipv4-address";
                leaf start-ipv4-address {
                    type inet:ipv4-address;
                    description
                        "Start IPv4 address for a range match.";
                }
                leaf end-ipv4-address {
                    type inet:ipv4-address;
                    description
                        "End IPv4 address for a range match.";
                }
            }
            description
                "Range match for an IPv4 address.";
        }
    }
    description
        "Grouping for an IPv4 address.";
grouping pkt-sec-ipv6 {
choice match-type {
  description
  "There are two types to configure a security policy
  for IPv6 address, such as exact match and range match.";
  case exact-match {
    uses ipv6;
    description
    "Exact match for an IPv6 address.";
  }
  case range-match {
    list range-ipv6-address {
      key "start-ipv6-address end-ipv6-address";
      leaf start-ipv6-address {
        type inet:ipv6-address;
        description
        "Start IPv6 address for a range match.";
      }
      leaf end-ipv6-address {
        type inet:ipv6-address;
        description
        "End IPv6 address for a range match.";
      }
      description
      "Range match for an IPv6 address.";
    }
    description
    "Grouping for IPv6 address.";
  }
  description
  "RFC 2460: Internet Protocol, Version 6 (IPv6)
  Specification - IPv6 address";
}

grouping pkt-sec-port-number {
choice match-type {
  description
  "There are two types to configure a security policy
  for a port number, such as exact match and range match.";
  case exact-match {
    leaf-list port-num {

type inet:port-number;
description
   "Exact match for a port number."
}
}
case range-match {
    list range-port-num {
        key "start-port-num end-port-num";
        leaf start-port-num {
            type inet:port-number;
            description
               "Start port number for a range match."
        }
        leaf end-port-num {
            type inet:port-number;
            description
               "Start port number for a range match."
        }
        description
           "Range match for a port number."
    }
}
description
   "Grouping for port number."

reference
   "RFC 793: Transmission Control Protocol - Port number
RFC 768: User Datagram Protocol - Port Number"
}

/*
 * Data nodes
 */

container i2nsf-security-policy {

description
   "Container for security policy
   including a set of security rules according to certain logic,
   i.e., their similarity or mutual relations, etc. The network
   security policy is able to apply over both the unidirectional
   and bidirectional traffic across the NSF.
   The I2NSF security policies use the Event-Condition-Action
   (ECA) policy model ";

reference
   "RFC 8329: Framework for Interface to Network Security
Functions - I2NSF Flow Security Policy Structure"
list system-policy {
  key "system-policy-name";
  description
    "The system-policy represents there could be multiple system policies in one NSF, and each system policy is used by one virtual instance of the NSF/device."

  leaf system-policy-name {
    type string;
    mandatory true;
    description
      "The name of the policy. This must be unique.";
  }

  leaf priority-usage {
    type identityref {
      base priority-usage-type;
    }
    default priority-by-order;
    description
      "Priority usage type for security policy rule: priority by order and priority by number";
  }

  leaf resolution-strategy {
    type identityref {
      base resolution-strategy;
    }
    default fmr;
    description
      "The resolution strategies can be used to specify how to resolve conflicts that occur between the actions of the same or different policy rules that are matched and contained in this particular NSF";

    reference
      "draft-ietf-i2nsf-capability-04: Information Model of NSFs Capabilities - Resolution strategy";
  }

  leaf default-action {

type identityref {
    base default-action;
}

default alert;
description
    "This default action can be used to specify a predefined action when no other alternative action was matched by the currently executing I2NSF Policy Rule. An analogy is the use of a default statement in a C switch statement."

reference
    "draft-ietf-i2nsf-capability-04: Information Model of NSFs Capabilities - Default action";
}

list rules {
    key "rule-name";
description
    "This is a rule for network security functions.";

leaf rule-name {
    type string;
    mandatory true;
description
    "The name of the rule. This must be unique.";
}

leaf rule-description {
    type string;
description
    "This description gives more information about rules.";
}

leaf rule-priority {
    type uint8 {
        range "1..255";
    }
description
    "The priority keyword comes with a mandatory numeric value which can range from 1 till 255.";
}

leaf rule-enable {
    type boolean;
description

"True is enable.
False is not enable."

container time-zone {
description "Time zone when the rules are applied";
container absolute-time-zone {
description "Rule execution according to absolute time";

leaf start-time {
type start-time-type;
default right-away;
description "Start time when the rules are applied";
}
leaf end-time {
type end-time-type;
default infinitely;
description "End time when the rules are applied";
}
}

container periodic-time-zone {
description "Rule execution according to periodic time";

container day {
description "Rule execution according to day.";
leaf every-day {
type boolean;
default true;
description "Rule execution every day";
}
leaf-list specific-day {
when "/every-day = 'false'";
type day-type;
description "Rule execution according to specific day";
}
}
container month {
    description
    "Rule execution according to month.";
    leaf every-month {
        type boolean;
        default true;
        description
        "Rule execution every day";
    }
    leaf-list specific-month {
        when "../every-month = 'false'";
        type month-type;
        description
        "Rule execution according to month day";
    }
}

container event-clause-container {
    description
    "An event is defined as any important occurrence in time of a change in the system being managed, and/or in the environment of the system being managed. When used in the context of policy rules for a flow-based NSF, it is used to determine whether the Condition clause of the Policy Rule can be evaluated or not. Examples of an I2NSF event include time and user actions (e.g., logon, logoff, and actions that violate any ACL.).";
    reference
draft-ietf-i2nsf-capability-04: Information Model of NSF's Capabilities - Design Principles and ECA Policy Model Overview
    leaf event-clause-description {
        type string;
        description
        "Description for an event clause";
    }
}
container event-clauses {
    description
        "It has two event types such as system event and system alarm."
    reference
draft-ietf-i2nsf-capability-04: Information Model of NSFs Capabilities - Design Principles and ECA Policy Model Overview
}

leaf-list system-event {
    type identityref {
        base system-event;
    }
    description
        "The security policy rule according to system events."
}

leaf-list system-alarm {
    type identityref {
        base system-alarm;
    }
    description
        "The security policy rule according to system alarms."
}
}

container condition-clause-container {
    description
        "A condition is defined as a set of attributes, features, and/or values that are to be compared with a set of known attributes, features, and/or values in order to determine whether or not the set of Actions in that (imperative) I2NSF Policy Rule can be executed or not. Examples of I2NSF Conditions include matching attributes of a packet or flow, and comparing the internal state of an NSF to a desired state.";
    reference
leaf condition-clause-description {
  type string;
  description
   "Description for a condition clause.";
}

contAINER packet-security-ipv4-condition {
  description
   "The purpose of this container is to represent IPv4 packet header information to determine if the set of policy actions in this ECA policy rule should be executed or not.";
  reference
   "RFC 791: Internet Protocol";

cONTAINER pkt-sec-ipv4-header-length {
  choice match-type {
    description
     "There are two types to configure a security policy for IPv4 header length, such as exact match and range match.";
    case exact-match {
      leaf-list ipv4-header-length {
        type uint8 {
          range "5..15";
        }
        description
         "Exact match for an IPv4 header length.";
      }
    }
    case range-match {
      list range-ipv4-header-length {
        key "start-ipv4-header-length end-ipv4-header-length";
        leaf start-ipv4-header-length {
          type uint8 {
            range "5..15";
          }
          description
           "Start IPv4 header length for a range match.";
        }
        leaf end-ipv4-header-length {
          type uint8 {
            range "5..15";
          }
          description
           "End IPv4 header length for a range match.";
        }
      }
    }
  }
}
range "5..15";
}
description
"End IPv4 header length for a range match."
}
description
"Range match for an IPv4 header length."
}
}
description
"The security policy rule according to IPv4 header length."
reference
"RFC 791: Internet Protocol - Header length"
}
leaf-list pkt-sec-ipv4-tos {
    type identityref {
        base type-of-service;
    }
description
"The security policy rule according to IPv4 type of service."
reference
"RFC 791: Internet Protocol - Type of service"
}
container pkt-sec-ipv4-total-length {
    choice match-type {
        description
        "There are two types to configure a security policy for IPv4 total length, such as exact match and range match."
        case exact-match {
            leaf-list ipv4-total-length {
                type uint16;
                description
                "Exact match for an IPv4 total length."
            }
        }
        case range-match {
            list range-ipv4-total-length {
                key "start-ipv4-total-length end-ipv4-total-length";
                leaf start-ipv4-total-length {
                    type uint16;
                    description
                    "Start IPv4 total length for a range match."
                }
            }
        }
    }
}
leaf end-ipv4-total-length {
  type uint16;
  description
    "End IPv4 total length for a range match.";
}

leaf-list pkt-sec-ipv4-id {
  type uint16;
  description
    "The security policy rule according to IPv4 identification.";
  reference
    "RFC 791: Internet Protocol - Identification"
}

leaf-list pkt-sec-ipv4-fragment-flags {
  type identityref {
    base fragmentation-flags-type;
  }
  description
    "The security policy rule according to IPv4 fragment flags.";
  reference
    "RFC 791: Internet Protocol - Fragment flags"
}

container pkt-sec-ipv4-fragment-offset {
  choice match-type {
    description
      "There are two types to configure a security policy for IPv4 fragment offset, such as exact match and range match.";
    case exact-match {
      leaf-list ipv4-fragment-offset {
        type uint16 {
          range "0..16383";
    

case range-match {
    list range-ipv4-fragment-offset {
        key "start-ipv4-fragment-offset
eend-ipv4-fragment-offset";
        leaf start-ipv4-fragment-offset {
            type uint16 {
                range "0..16383";
            }
            description
                "Start IPv4 fragment offset for a range match.";
        }
        leaf end-ipv4-fragment-offset {
            type uint16 {
                range "0..16383";
            }
            description
                "End IPv4 fragment offset for a range match.";
        }
        description
            "Range match for an IPv4 fragment offset.";
    }
}

description
    "The security policy rule according to
    IPv4 fragment offset.";
reference
    "RFC 791: Internet Protocol - Fragment offset";
}
case range-match {
  list range-ipv4-ttl {
    key "start-ipv4-ttl end-ipv4-ttl";
    leaf start-ipv4-ttl {
      type uint8;
      description
      "Start IPv4 TTL for a range match.";
    }
    leaf end-ipv4-ttl {
      type uint8;
      description
      "End IPv4 TTL for a range match.";
    }
    description
    "Range match for an IPv4 TTL."
  }
  description
  "The security policy rule according to IPv4 time-to-live (TTL)."
  reference
  "RFC 791: Internet Protocol - Time to live"
}

leaf-list pkt-sec-ipv4-protocol {
  type identityref {
    base protocol;
  }
  description
  "The security policy rule according to IPv4 protocol."
  reference
  "RFC 791: Internet Protocol - Protocol"
}

container pkt-sec-ipv4-src {
  uses pkt-sec-ipv4;
  description
  "The security policy rule according to IPv4 source address."
  reference
  "RFC 791: Internet Protocol - IPv4 Address"
}

container pkt-sec-ipv4-dest {
  uses pkt-sec-ipv4;
description
"The security policy rule according to IPv4 destination address.";
reference
"RFC 791: Internet Protocol - IPv4 Address";
}

leaf-list pkt-sec-ipv4-ipopts {
type identityref {
  base ipopts;
}
description
"The security policy rule according to IPv4 options.";
reference
"RFC 791: Internet Protocol - Options";
}

leaf pkt-sec-ipv4-sameip {
type boolean;
description
"Every packet has a source IP-address and a destination IP-address. It can be that the source IP is the same as the destination IP.";
}

leaf-list pkt-sec-ipv4-geoip {
type string;
description
"The geoip keyword enables you to match on the source, destination or source and destination IP addresses of network traffic and to see to which country it belongs. To do this, Suricata uses GeoIP API with MaxMind database format.";
}

container packet-security-ipv6-condition {
description
"The purpose of this container is to represent IPv6 packet header information to determine if the set of policy actions in this ECA policy rule should be executed or not.";
reference
leaf-list pkt-sec-ipv6-traffic-class {
  type identityref {
    name traffic-class;
  }
  description "The security policy rule according to IPv6 traffic class.";
  reference "RFC 2460: Internet Protocol, Version 6 (IPv6)
  Specification - Traffic class";
}

container pkt-sec-ipv6-flow-label {
  choice match-type {
    description "There are two types to configure a security policy for IPv6 flow label, such as exact match and range match.";
    case exact-match {
      leaf-list ipv6-flow-label {
        type uint32 {
          range "0..1048575";
        }
        description "Exact match for an IPv6 flow label.";
      }
    }
    case range-match {
      list range-ipv6-flow-label {
        key "start-ipv6-flow-label end-ipv6-flow-label";
        leaf start-ipv6-flow-label {
          type uint32 {
            range "0..1048575";
          }
          description "Start IPv6 flow label for a range match.";
        }
        leaf end-ipv6-flow-label {
          type uint32 {
            range "0..1048575";
          }
          description "End IPv6 flow label for a range match.";
        }
        description "Range match for an IPv6 flow label.";
      }
    }
  }
}

description
"The security policy rule according to IPv6 flow label."
reference
}

container pkt-sec-ipv6-payload-length {
  choice match-type {
    description
    "There are two types to configure a security policy for IPv6 payload length, such as exact match and range match."
    case exact-match {
      leaf-list ipv6-payload-length {
        type uint16;
        description
        "Exact match for an IPv6 payload length."
      }
    }
    case range-match {
      list range-ipv6-payload-length {
        key "start-ipv6-payload-length end-ipv6-payload-length";
        leaf start-ipv6-payload-length {
          type uint16;
          description
          "Start IPv6 payload length for a range match."
        }
        leaf end-ipv6-payload-length {
          type uint16;
          description
          "End IPv6 payload length for a range match."
        }
        description
        "Range match for an IPv6 payload length."
      }
    }
  }
  description
  "The security policy rule according to IPv6 payload length."
  reference
  "RFC 2460: Internet Protocol, Version 6 (IPv6) Specification - Payload length";
}
leaf-list pkt-sec-ipv6-next-header {
  type identityref {
    base next-header;
  }
  description
    "The security policy rule according to IPv6 next header.";
  reference
}

container pkt-sec-ipv6-hop-limit {
  choice match-type {
    description
      "There are two types to configure a security policy for IPv6 hop limit, such as exact match and range match.";
    case exact-match {
      leaf-list ipv6-hop-limit {
        type uint8;
        description
          "Exact match for an IPv6 hop limit.";
      }
    }
    case range-match {
      list range-ipv6-hop-limit {
        key "start-ipv6-hop-limit end-ipv6-hop-limit";
        leaf start-ipv6-hop-limit {
          type uint8;
          description
            "Start IPv6 hop limit for a range match.";
        }
        leaf end-ipv6-hop-limit {
          type uint8;
          description
            "End IPv6 hop limit for a range match.";
        }
        description
          "Range match for an IPv6 hop limit.";
      }
    }
  }
  description
    "The security policy rule according to IPv6 hop limit.";
  reference
}
container pkt-sec-ipv6-src {
  uses pkt-sec-ipv6;
  description
    "The security policy rule according to IPv6 source address.";
  reference
    "RFC 2460: Internet Protocol, Version 6 (IPv6) Specification - IPv6 address";
}

container pkt-sec-ipv6-dest {
  uses pkt-sec-ipv6;
  description
    "The security policy rule according to IPv6 destination address.";
  reference
    "RFC 2460: Internet Protocol, Version 6 (IPv6) Specification - IPv6 address";
}

container packet-security-tcp-condition {
  description
    "The purpose of this container is to represent TCP packet header information to determine if the set of policy actions in this ECA policy rule should be executed or not.";
  reference
    "RFC 793: Transmission Control Protocol";
}

container pkt-sec-tcp-src-port-num {
  uses pkt-sec-port-number;
  description
    "The security policy rule according to tcp source port number.";
  reference
    "RFC 793: Transmission Control Protocol - Port number";
}

container pkt-sec-tcp-dest-port-num {
  uses pkt-sec-port-number;
  description

"The security policy rule according to tcp destination port number.";
reference
"RFC 793: Transmission Control Protocol
 - Port number";

} 

container pkt-sec-tcp-seq-num { 
  choice match-type { 
    description
      "There are two types to configure a security policy for tcp sequence number,
      such as exact match and range match.";
    case exact-match { 
      leaf-list tcp-seq-num { 
        type uint32; 
        description
          "Exact match for an tcp sequence number.";
      } 
    } 
    case range-match { 
      list range-tcp-seq-num { 
        key "start-tcp-seq-num end-tcp-seq-num";
        leaf start-tcp-seq-num { 
          type uint32; 
          description
            "Start tcp sequence number for a range match.";
        } 
        leaf end-tcp-seq-num { 
          type uint32; 
          description
            "End tcp sequence number for a range match.";
        } 
        description
          "Range match for a tcp sequence number.";
      } 
    } 
  } 
  description
    "The security policy rule according to tcp sequence number.";
  reference
    "RFC 793: Transmission Control Protocol
    - Sequence number";
} 

container pkt-sec-tcp-ack-num { 
  choice match-type { 

description
"There are two types to configure a security policy for tcp acknowledgement number, such as exact match and range match."

case exact-match {
    leaf-list tcp-ack-num {
        type uint32;
        description
        "Exact match for a tcp acknowledgement number.";
    }
}

case range-match {
   list range-tcp-ack-num {
        key "start-tcp-ack-num end-tcp-ack-num";
        leaf start-tcp-ack-num {
            type uint32;
            description
            "Start tcp acknowledgement number for a range match.";
        }
        leaf end-tcp-ack-num {
            type uint32;
            description
            "End tcp acknowledgement number for a range match.";
        }
        description
        "Range match for a tcp acknowledgement number.";
    }
}

description
"The security policy rule according to tcp acknowledgement number.";
reference
"RFC 793: Transmission Control Protocol - Acknowledgement number";

container pkt-sec-tcp-window-size {
    choice match-type {
        description
        "There are two types to configure a security policy for tcp window size, such as exact match and range match.";
        case exact-match {
            leaf-list tcp-window-size {
                type uint16;
            }
        }
    }
case range-match {
    list range-tcp-window-size {
        key "start-tcp-window-size end-tcp-window-size";
        leaf start-tcp-window-size {
            type uint16;
            description "Start tcp window size for a range match.";
        }
        leaf end-tcp-window-size {
            type uint16;
            description "End tcp window size for a range match.";
        }
        description "Range match for a tcp window size.";
    }
    description "The security policy rule according to tcp window size.";
    reference "RFC 793: Transmission Control Protocol - Window size";
}

leaf-list pkt-sec-tcp-flags {
    type identityref {
        base tcp-flags;
    }
    description "The security policy rule according to tcp flags.";
    reference "RFC 793: Transmission Control Protocol - Flags";
}

container packet-security-udp-condition {
    description "The purpose of this container is to represent UDP packet header information to determine
if the set of policy actions in this ECA policy rule should be executed or not.

container pkt-sec-udp-src-port-num {
  uses pkt-sec-port-number;
  description
  "The security policy rule according to udp source port number.";
  reference
  "RFC 793: Transmission Control Protocol - Port number";
}

container pkt-sec-udp-dest-port-num {
  uses pkt-sec-port-number;
  description
  "The security policy rule according to udp destination port number.";
  reference
  "RFC 768: User Datagram Protocol - Total Length";
}

container pkt-sec-udp-total-length {
  choice match-type {
    description
    "There are two types to configure a security policy for udp sequence number, such as exact match and range match.";
    case exact-match {
      leaf-list udp-total-length {
        type uint32;
        description
        "Exact match for an udp-total-length.";
      }
    }
    case range-match {
      list range-udp-total-length {
        key "start-udp-total-length end-udp-total-length";
        leaf start-udp-total-length {
          type uint32;
          description
          "Start udp total length for a range match.";
        }
        leaf end-udp-total-length {
        }
type uint32;
description
"End udp total length for a range match."
}
description
"Range match for a udp total length."
}
}
description
"The security policy rule according to
udp total length."
reference
"RFC 768: User Datagram Protocol
- Total Length"
}
}

container packet-security-icmp-condition {
description
"The purpose of this container is to represent
ICMP packet header information to determine
if the set of policy actions in this ECA policy
rule should be executed or not.";
reference
"RFC 792: Internet Control Message Protocol
RFC 8335: PROBE: A Utility for Probing Interfaces"

leaf-list pkt-sec-icmp-type-and-code {
type identityref {
  base icmp-type;
} 
description
"The security policy rule according to
ICMP parameters.";
reference
"RFC 792: Internet Control Message Protocol
RFC 8335: PROBE: A Utility for Probing Interfaces"
}
}

container packet-security-http-condition {
description
"Condition for http."

leaf-list pkt-sec-uri-content {
type string;
description
"The security policy rule according to uri content."
}

leaf-list pkt-sec-url-content {
  type string;
  description
  "The security policy rule according to url content."
}
}

container packet-security-voice-condition {
  description
  "For the VoIP/VoLTE security system, a VoIP/VoLTE security system can monitor each VoIP/VoLTE flow and manage VoIP/VoLTE security rules controlled by a centralized server for VoIP/VoLTE security service (called VoIP IPS). The VoIP/VoLTE security system controls each switch for the VoIP/VoLTE call flow management by manipulating the rules that can be added, deleted, or modified dynamically."
  reference
  "RFC 3261: SIP: Session Initiation Protocol"
}

leaf-list pkt-sec-src-voice-id {
  type string;
  description
  "The security policy rule according to a source voice ID for VoIP and VoLTE."
}

leaf-list pkt-sec-dest-voice-id {
  type string;
  description
  "The security policy rule according to a destination voice ID for VoIP and VoLTE."
}

leaf-list pkt-sec-user-agent {
  type string;
  description
  "The security policy rule according to an user agent for VoIP and VoLTE."
}

container packet-security-ddos-condition {
    description "Condition for DDoS attack."

    leaf pkt-sec-alert-rate {
        type uint32;
        description "The alert rate of flood detect for same packets."
    }
}

container action-clause-container {
    description "An action is used to control and monitor aspects of flow-based NSFs when the event and condition clauses are satisfied. NSFs provide security functions by executing various Actions. Examples of I2NSF Actions include providing intrusion detection and/or protection, web and flow filtering, and deep packet inspection for packets and flows."

    leaf action-clause-description {
        type string;
        description "Description for an action clause."
    }
}

container packet-action {
    description "Action for packets"

    leaf ingress-action {

type identityref {
  base ingress-action;
}
description
  "Action: pass, drop, reject, alert, and mirror."
}

leaf egress-action {
  type identityref {
    base egress-action;
  }
description
  "Egress action: pass, drop, reject, alert, mirror, invoke-signaling, tunnel-encapsulation, forwarding, and redirection."
}

leaf log-action {
  type identityref {
    base log-action;
  }
description
  "Log action: rule log and session log"
}

}

container advanced-action {
  description
  "If the packet need be additionally inspected, the packet are passed to advanced network security functions according to the profile."
  reference
  "RFC 8329: Framework for Interface to Network Security Functions - Differences from ACL Data Models"

  leaf-list content-security-control {
    type identityref {
      base content-security-control;
    }
description
      "The Profile is divided into content security control and attack-mitigation-control. Content security control: antivirus, ips, ids, url filtering, mail filtering, file blocking, file isolate, packet capture, application control, voip and volte."
  }
}
leaf-list attack-mitigation-control {
  type identityref {
    base attack-mitigation-control;
  }
}

Figure 5: YANG Data Module of I2NSF NSF-Facing-Interface

6. IANA Considerations

This document requests IANA to register the following URI in the "IETF XML Registry" [RFC3688]:


Registrant Contact: The IESG.

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

This document requests IANA to register the following YANG module in the "YANG Module Names" registry [RFC7950].

name: ietf-i2nsf-policy-rule-for-nsf


prefix: iiprfn

reference: RFC XXXX
7. Security Considerations

The YANG module specified in this document defines a data schema designed to be accessed through network management protocols such as NETCONF [RFC6241] or RESTCONF [RFC8040]. The lowest NETCONF layer is the secure transport layer, and the required transport secure transport is Secure Shell (SSH) [RFC6242]. The lowest RESTCONF layer is HTTPS, and the required transport secure transport is TLS [RFC8446].

The NETCONF access control model [RFC8341] provides a means of restricting access to specific NETCONF or RESTCONF users to a preconfigured subset of all available NETCONF or RESTCONF protocol operations and content.

8. References

8.1. Normative References


8.2. Informative References

[i2nsf-advanced-nsf-dm]

[i2nsf-nsf-cap-dm]

[i2nsf-nsf-cap-im]
Appendix A. Configuration Examples

This section shows configuration examples of "ietf-i2nsf-policy-rule-for-nsf" module for security policy rules of network security devices. For security requirements, we assume that the NSFs (i.e., General firewall, Time based firewall, Web filter, VoIP/VoLTE filter http and https flood mitigation) described in Appendix A. Configuration Examples of [i2nsf-nsf-cap-dm] are registered in I2NSF framework. With the registered NSFs, we show configuration examples for security policy rules of network security functions according to the following three security requirements: (i) Block SNS access during business hours, (ii) Block malicious VoIP/VoLTE packets coming to the company, and (iii) Mitigate http and https flood attacks on company web server.

A.1. Security Requirement 1: Block SNS Access during Business Hours

This section shows a configuration example for blocking SNS access during business hours.
<i2nsf-security-policy
xmlns="urn:ietf:params:xml:ns:yang:i2nsf-policy-rule-for-nsf">
<system-policy>
  <system-policy-name>sns_access</system-policy-name>
  <rules>
    <rule-name>block_sns_access_during_operation_time</rule-name>
    <time-zone>
      <absolute-time-zone>
        <start-time>09:00:00Z</start-time>
        <end-time>18:00:00Z</end-time>
      </absolute-time-zone>
    </time-zone>
    <condition-clause-container>
      <packet-security-ipv4-condition>
        <pkt-sec-ipv4-src>
          <range-ipv4-address>
            <start-ipv4-address>221.159.112.1</start-ipv4-address>
            <end-ipv4-address>221.159.112.90</end-ipv4-address>
          </range-ipv4-address>
        </pkt-sec-ipv4-src>
      </packet-security-ipv4-condition>
    </condition-clause-container>
    <action-clause-container>
      <advanced-action>
        <content-security-control>url-filtering</content-security-control>
      </advanced-action>
    </action-clause-container>
  </rules>
</system-policy>
</i2nsf-security-policy>

Figure 6: Configuration XML for Time based Firewall to Block SNS Access during Business Hours
<i2nsf-security-policy
  xmlns="urn:ietf:params:xml:ns:yang:ietf-i2nsf-policy-rule-for-nsf">
  <system-policy>
    <system-policy-name>sns_access</system-policy-name>
    <rules>
      <rule-name>block_facebook_and_instagram</rule-name>
      <condition-clause-container>
        <packet-security-http-condition>
          <pkt-sec-url-content>facebook</pkt-sec-url-content>
          <pkt-sec-url-content>instagram</pkt-sec-url-content>
        </packet-security-http-condition>
      </condition-clause-container>
      <action-clause-container>
        <packet-action>
          <egress-action>drop</egress-action>
        </packet-action>
      </action-clause-container>
    </rules>
  </system-policy>
</i2nsf-security-policy>

Figure 7: Configuration XML for Web Filter to Block SNS Access during Business Hours

Figure 6 and Figure 7 show the configuration XML documents for time based firewall and web filter to block SNS access during business hours. For the security requirement, two NSFs (i.e., a time based firewall and a web filter) were used because one NSF can not meet the security requirement. The instances of XML documents for the time based firewall and the web filter are as follows: Note that a detailed data model for the configuration of the advanced network security function (i.e., web filter) is described in [i2nsf-advanced-nsf-dm].

Time based Firewall

1. The name of the system policy is sns_access.

2. The name of the rule is block_sns_access_during_operation_time.

3. The rule is operated during the business hours (i.e., from 9 a.m. to 6 p.m.).

4. The rule inspects a source IPv4 address (i.e., from 221.159.112.1 to 221.159.112.90) to inspect the outgoing packets of employees.
5. If the outgoing packets match the rules above, the time based firewall sends the packets to url filtering for additional inspection because the time based firewall can not inspect contents of the packets for the SNS URL.

Web Filter

1. The name of the system policy is sns_access.

2. The name of the rule is block_facebook_and_instagram.

3. The rule inspects URL address to block the access packets to the facebook or the instagram.

4. If the outgoing packets match the rules above, the packets are blocked.

A.2. Security Requirement 2: Block Malicious VoIP/VoLTE Packets Coming to the Company

This section shows a configuration example for blocking malicious VoIP/VoLTE packets coming to the company.
<i2nsf-security-policy
xmlns="urn:ietf:params:xml:ns:yang:ietf-i2nsf-policy-rule-for-nsf">
  <system-policy>
    <system-policy-name>voip_volte_inspection</system-policy-name>
    <rules>
      <rule-name>block_malicious_voip_volte_packets</rule-name>
      <condition-clause-container>
        <packet-security-ipv4-condition>
          <pkt-sec-ipv4-dest>
            <range-ipv4-address>
              <start-ipv4-address>221.159.112.1</start-ipv4-address>
              <end-ipv4-address>221.159.112.90</end-ipv4-address>
            </range-ipv4-address>
          </pkt-sec-ipv4-dest>
        </packet-security-ipv4-condition>
        <packet-security-tcp-condition>
          <pkt-sec-tcp-dest-port-num>
            <port-num>5060</port-num>
            <port-num>5061</port-num>
          </pkt-sec-tcp-dest-port-num>
        </packet-security-tcp-condition>
      </condition-clause-container>
      <action-clause-container>
        <advanced-action>
          <content-security-control>voip-volte</content-security-control>
        </advanced-action>
      </action-clause-container>
    </rules>
  </system-policy>
</i2nsf-security-policy>

Figure 8: Configuration XML for General Firewall to Block Malicious VoIP/VoLTE Packets Coming to the Company
<i2nsf-security-policy
xmlns="urn:ietf:params:xml:ns:yang:ietf-i2nsf-policy-rule-for-nsf">
<system-policy>
  <system-policy-name>malicious_voice_id</system-policy-name>
  <rules>
    <rule-name>block_malicious_voice_id</rule-name>
    <condition-clause-container>
      <packet-security-voice-condition>
        <pkt-sec-src-voice-id>11111@voip.black.com</pkt-sec-src-voice-id>
        <pkt-sec-src-voice-id>22222@voip.black.com</pkt-sec-src-voice-id>
      </packet-security-voice-condition>
    </condition-clause-container>
    <action-clause-container>
      <packet-action>
        <ingress-action>drop</ingress-action>
      </packet-action>
    </action-clause-container>
  </rules>
</system-policy>
</i2nsf-security-policy>

Figure 9: Configuration XML for VoIP/VoLTE Filter to Block Malicious VoIP/VoLTE Packets Coming to the Company

Figure 8 and Figure 9 show the configuration XML documents for general firewall and VoIP/VoLTE filter to block malicious VoIP/VoLTE packets coming to the company. For the security requirement, two NSFs (i.e., a general firewall and a VoIP/VoLTE filter) were used because one NSF can not meet the security requirement. The instances of XML documents for the general firewall and the VoIP/VoLTE filter are as follows: Note that a detailed data model for the configuration of the advanced network security function (i.e., VoIP/VoLTE filter) is described in [i2nsf-advanced-nsf-dm].

General Firewall

1. The name of the system policy is voip_volte_inspection.
2. The name of the rule is block_malicious_voip_volte_packets.
3. The rule inspects a destination IPv4 address (i.e., from 221.159.112.1 to 221.159.112.90) to inspect the packets coming into the company.
4. The rule inspects a port number (i.e., 5060 and 5061) to inspect VoIP/VoLTE packet.

5. If the incoming packets match the rules above, the general firewall sends the packets to VoIP/VoLTE filter for additional inspection because the general firewall can not inspect contents of the VoIP/VoLTE packets.

VoIP/VoLTE Filter

1. The name of the system policy is malicious_voice_id.

2. The name of the rule is block_malicious_voice_id.

3. The rule inspects the voice id of the VoIP/VoLTE packets to block the malicious VoIP/VoLTE packets (i.e., 11111@voip.black.com and 22222@voip.black.com).

4. If the incoming packets match the rules above, the packets are blocked.


This section shows a configuration example for mitigating http and https flood attacks on a company web server.
Figure 10: Configuration XML for General Firewall to Mitigate HTTP and HTTPS Flood Attacks on a Company Web Server
<i2nsf-security-policy
xmlns="urn:ietf:params:xml:ns:yang:ietf-i2nsf-policy-rule-for-nsf">
  <system-policy>
    <system-policy-name>http_and_https_flood_attack_mitigation</system-policy-name>
    <rules>
      <rule-name>100_per_second</rule-name>
      <condition-clause-container>
        <packet-security-ddos-condition>
          <pkt-sec-alert-rate>100</pkt-sec-alert-rate>
        </packet-security-ddos-condition>
      </condition-clause-container>
      <action-clause-container>
        <packet-action>
          <ingress-action>drop</ingress-action>
        </packet-action>
      </action-clause-container>
    </rules>
  </system-policy>
</i2nsf-security-policy>

Figure 11: Configuration XML for HTTP and HTTPS Flood Attack Mitigation to Mitigate HTTP and HTTPS Flood Attacks on a Company Web Server

Figure 10 and Figure 11 show the configuration XML documents for general firewall and http and https flood attack mitigation to mitigate http and https flood attacks on a company web server. For the security requirement, two NSFs (i.e., a general firewall and a http and https flood attack mitigation) were used because one NSF can not meet the security requirement. The instances of XML documents for the general firewall and http and https flood attack mitigation are as follows: Note that a detailed data model for the configuration of the advanced network security function (i.e., http and https flood attack mitigation) is described in [i2nsf-advanced-nsf-dm].

General Firewall

1. The name of the system policy is flood_attack_mitigation.

2. The name of the rule is mitigate_http_and_https_flood_attack.

3. The rule inspects a destination IPv4 address (i.e., 221.159.112.95) to inspect the access packets coming into the company web server.
4. The rule inspects a port number (i.e., 80 and 443) to inspect http and https packet.

5. If the packets match the rules above, the general firewall sends the packets to http and https flood attack mitigation for additional inspection because the general firewall can not control the amount of packets for http and https packets.

HTTP and HTTPS Flood Attack Mitigation

1. The name of the system policy is http_and_https_flood_attack_mitigation.

2. The name of the rule is 100_per_second.

3. The rule controls the http and https packets according to the amount of incoming packets.

4. If the incoming packets match the rules above, the packets are blocked.

Appendix B. Changes from draft-ietf-i2nsf-nsf-facing-interface-dm-02

The following changes are made from draft-ietf-i2nsf-nsf-facing-interface-dm-03:

- We revised this YANG data module according to guidelines for authors and reviewers of YANG data model documents [RFC6087].

- We changed the structure of the overall YANG data model.

- We added exact-range type as well as range-based type for the range policy rules.

- We changed enumeration type to identity type for scalable components.

- We added a description for the YANG tree diagram of the YANG data module.

- We revised overall sentences of this YANG data model document.

- We added configuration examples to make it easier for reviewers to understand.
Appendix C. Acknowledgments

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Appendix D. Contributors

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