I2NSF
Internet-Draft
Intended status: Standards Track
Expires: January 9, 2017

S. Hares
Huawei
R. Moskowitz
HTT Consulting
July 8, 2016

Inter-Cloud DDOS API Yang Model
draft-hares-i2nsf-ddos-yang-dm-00.txt

Abstract

This document defines a yang model that enables two Cloud providers to exchange DDoS based on Inter-Cloud DDoS Mitigation API [draft-fang-i2nsf-inter-cloud-ddos-mitigation-api-01].

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at http://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on January 9, 2017.

Table of Contents

1. Introduction

[I-D.ietf-i2nsf-problem-and-use-cases] proposes two different types of interfaces:

- North-bound interface (NBI) provided by the network security functions (NSFs)

- Interface between I2NSF user/client with network controller:

Cloud Providers need to have a NBI to the network security functions that can share DDoS information.

This document defines a yang data models based [I-D.fang-i2nsf-inter-cloud-ddos-mitigation-api] using the Yang model to provide the interface. This yang data module uses the ietf-i2nsf-capability model found in [draft-hres-i2nsf-capability-yang] which is based on the informational model found in on the [I-D.xia-i2nsf-capability-interface-im], and initial work done in [I-D.xia-i2nsf-service-interface-dm]. Terms used in document are defined in [I-D.ietf-i2nsf-terminology].

This yang data model assumes the inter-cloud interface looks like this:

```
  Cloud-Provider-1         Cloud Provider 2
  [client-software]<------> [agent software]
  [agent-software] <------->[client software]
```

The client-software reads/writes the data in the remote cloud environment. The agent software responds with information on this cloud.

[I-D.xia-i2nsf-capability-interface-im] defines the following type of functionality in NSFs.

o network security control

o content security control, and

o attack mitigation control

This document contains high-level yang for each type of control. The features in each section have been built up from the following sources:

open-source: firewalls, IDS, IPS. This includes ECA policy for

basic-firewalls: in router, switches, firewalls,

firewall products commercial level

specialized devices IDS, IPS

2. Using this Yang module to implement the Inter-Cloud API

This yang module can be used by a clouder provider to consume another cloud provider’s services, or to provide services for another cloud provider. For example, Cloud Provider A can be a consumer of Cloud Provider B via logical interface link 1 (shown in figure 1 below). Cloud Provider B can be a consumer of Cloud Provider A via logical link 2.

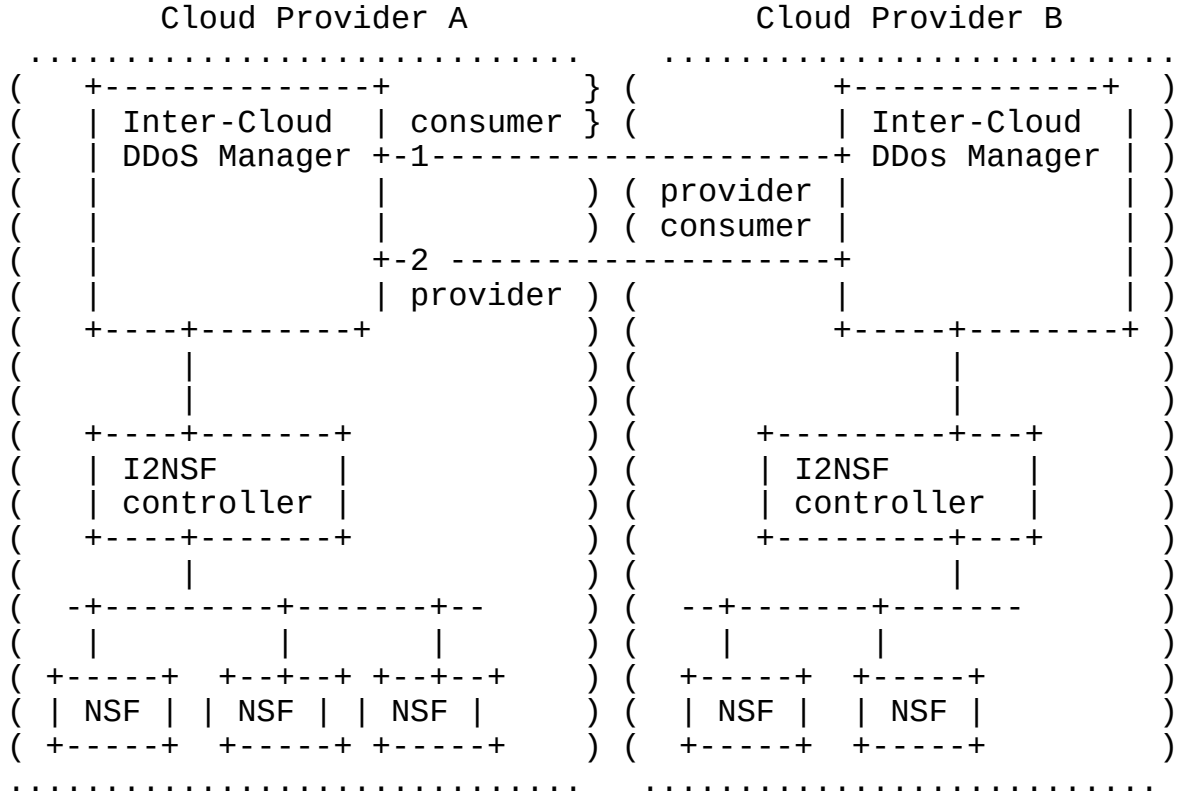
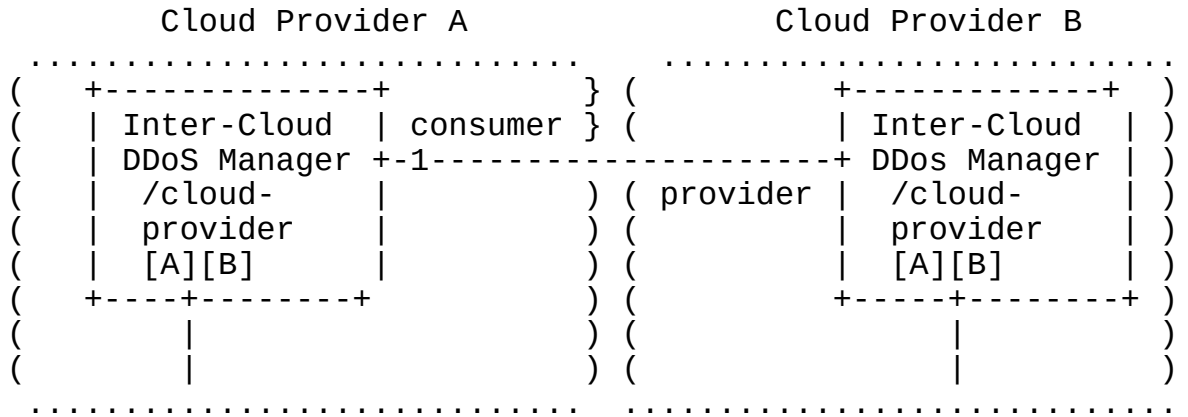


Figure 1: Two cloud providers using Inter-Cloud DDoS API via yang module

The yang module provides a list of cloud-provider structures indexed by name. Within the cloud-provider structure there is a name (e.g. Cloud Provider A), and API types (consumer or provider or both), and security identity key. These features allow the



3. Inter-Cloud DDOS Yang Module

This section describes the Inter-Cloud DDoS Yang module. This section includes the following:

- high-level yang for ietf-i2nsf-cloud-DDoS yang module,
- mapping of Inter-Cloud API ([I-D.fang-i2nsf-inter-cloud-ddos-mitigation-api]) to specific Yang structures and NETCONF/RESTCONF function. The NETCONF/ RESTCONF functions include NETCONF/RESTCONF calls, publication/ subscription (pub/sub) push functional (I2RS requires pub/sub), and opstate.
- Overview of module utilized by ietf-i2nsf-cloud-DDoS yang module

3.1. High-level Yang modules

The this section has the high-level yang for ietf-i2nsf-cloud-ddos module. This module references the following submodules contained in this draft: cfg-cloud-mitigate-policy, cfg-mitigate-monitoring, i2nsf-capabilities, and cloud-mitigate-opstate.

Other data models that this module depends on are described in the next section.

- ietf-i2nsf-capability module [I-D.hares-i2nsf-capability-yang] (which is based on the information model in [I-D.xia-i2nsf-capability-interface-im])
- ietf-pkt-eca modulde in [I-D.ietf-i2rs-pkt-eca-data-model], and
- ietf-fb-rib module in [I-D.ietf-i2rs-fb-rib-data-model].

3.1.1. ietf-i2nsf-cloud-ddos Main module

```
ietf-i2nsf-cloud-ddos
 +--rw i2nsf-intercloud-ddos
    +--rw cloud-provider* [name]
       +--rw cloud-name string;
           +--rw cloud-api-type identitref
       +--rw cloud-sec-id  uint64
           +--rw Inter-Cloud-DDoS-capabilities
           |  +--rw capability-query boolean
           |  +--rw mitigation-req boolean
           |  +--rw monitor-report boolean
       |  +--rw monitor-parms boolean
           |  +--rw knowledge-share boolean
```

```
             +--rw cfg-attack-mitigate-policy* [policy-id]
            +--rw policy-id uint64
            +--rw policy-name string
                    +--rw cfg-active boolean //policy cfg active
            +--rw cfg-mitigate-policy
                    |  uses cfg-cloud-mitigate-policy
            +--rw cfg-monitoring-policy* [mon-policy-id]
                    |  +--rw mon-policy-id uint64
            |  uses cfg-mitigate-monitoring
                    +--rw opstate-exists boolean
             +--rw cfg-cloud-capabilities
             |   uses i2nsf-capabilities
             +--ro mitigation-opstate
             |  +--ro mitigation-policy* [policy-id]
             |  |  +--ro policy-id  uint32
         |  |  +--ro status
             |  |  | uses cloud-mitigate_opstate

      rpc:
         +--x start-mitigation
         | ...
         +--x stop-mitigation [policy-id]
         | ...
             +--x reset opstate-counters
         | ...

      notifications:
             +--n inter-cloud-capability-change
             |  ...
         +--n policy-change
         | ...
             +--n opstate-reset
             | ...
             +--n mitigation-failure
             | ..
```

Figure 1: ietf-i2nsf-cloud-DDos Model
High level yang structure

3.1.2. cfg-cfg-cloud-mitigate-policy sub-module

```
     +--rw cfg-cloud-mitigate-policy* []
        +--rw flood-rate-limit
        |  +--rw max-rate integer
            +--rw syn-flood-mitigation*
            |  +--rw SFM-APP-name string
            +--rw tcp-flood-protection*
            |  +--rw TFP-APP-name  string
            +--rw udp-flood-mitigation*
            |  +--rw SFM-APP-name string
            +--rw max-connect-rate
        |  +--rw interval uin632
        |  +--rw rate uint64
            +--rw max-newconnect-rate
        |  +--rw interval uint32
        |  +--rw rate uint64
            +--rw frag-packet-rate
        |  +--rw interval uint32
        |  +--rw rate uint64
            +--rw packet-rate
        |  +--rw interval uint32
        |  +--rw rate uint64
            +--rw max-newconnect-rate
        |  +--rw interval uint32
        |  +--rw rate     uint64
            +--rw black-hole-function*
        |  +--rw BPF-AP1-name string
            +--rw 32-type-rate
            |  +--rw mitigation-type string
            |  +--rw rate  uint64
        +--rw bgp-signals
            | +--rw 24-community boolean
            | +--rw slash-24-removal bpolean
            +--rw bgp-flowspec-policy
            |  uses fb-rib:ietf-fb-rib:bgp-fb-rib
```

Figure 2: Configured cloud mitigation policy
High level yang structure

3.1.3. Operational state (cloud-mitigation_opstate)

```
     +--ro cloud-mitigate_opstate
        +--ro stats-reset-id   uint64
        +--ro support-opstate [stats-pull-id]
            |  +--ro traffic-cnts    boolean
            |  +--ro mitigation-cnts boolean
            |  +--ro sflow-monitoring bollean
            |  +--ro share-blacklist boolean
            +--ro traffic-cnts
            |  +--ro pkts-matched uint64
            |  +--ro bytes-matches uint64
            +--ro mitigation-cnt
           +--ro hit-flood-rate-limit uint64
               +--ro used-sync-mitigation uint64
           +--ro used TCP-flood     uint64
               +--ro used UDP-flood     uint64
           +--ro hit-connect-max    uint64
           +--ro hit-newconnect-max uint64
                   +--ro hit-frag-packet-rate-max  uint64
                   +--ro hit-packet-rate-max       uint64
                   +--ro hit-newconnect-rate-max   uint64
              +--ro used-blackhole       uint64
              +--ro used-bgp-signals     uint64
                  |  +--ro used-24-community      uint64
                  |  +--ro used-slash-24-removal  uint64
              +--ro bgpflowspec-stat   uint64
              |  uses fb-rib:ietf-fb-rib:bgp-fb-rib
            +--ro knowledge-sharing
              +--ro current-blacklist* [blacklist-id]
                  |  +--ro black-list-id uint32
                  |  +--ro ipv4-address ipv4-addr
                  |  +--ro ipv6-address ipv6-addr
                  |  +--ro transport-port uint16
                  |  (need input on black list or
                  |   existing yang model with)
```

Figure x - Operational state

3.1.4. Configuring Montoring (cfg-mitigate-monitoring module)

```
   +--rw cfg-mitigate-monitoring
      +--rw opstate-monitoring
      |  +--rw traffic-stats  boolean
      |  +--rw detail-stats   boolean
      |  +--rw sflow-stats    boolean
      |  +--rw share-blacklist boolean
      |  +--rw pub-sub-retrieve boolean
      |  +--rw get-retrieve boolean
      +--rw sflow-redirect [endpoint-id]
         +--rw endpoint-id uint64
             +--rw endpoint-name string
             +--rw sflow-enabled boolean
             +--rw endpoint-ip   ip-addr
             +--rw start-time-sec uint64 //unix time second
         +--rw stop-time-sec  uint64 //unix time seconds
```

3.1.5. rpcs for Inter-Cloud Yang Module

rpc for Inter-Cloud Yang modules

```
      rpc:
         +--x start-mitigation
         |  +--input
         |  |  +--w cloud-name string
              |  |  +--w cloud-api-type identitref
         |  |  +--w cloud-sec-id  uint64
              |  |  +--w policy-id     uint64
         |  |  +--w request-identifier uint64
              |  |  +--w cfg-mitigation-type
              |  |  +--w params
              |  +--output
         |  |  +--w cloud-name string
              |  |  +--w cloud-api-type identitref
         |  |  +--w cloud-sec-id  uint64
              |  |  +--w policy-id     uint64
         |  |  +--w cfg-mitigation  boolean
              |  |  +--ro status identityref /reject, started, done
         |  |  +--ro cfg-mitigation-type string
              |  |  +--ro result-params
              |  |  |  (choice based on type )
         +--x stop-mitigation [policy-id]
         |  +--input
         |  |  +--w cloud-name string
              |  |  +--w cloud-api-type identitref
         |  |  +--w cloud-sec-id  uint64
              |  |  +--w policy-id     uint64
         |  |  +--w request-identifier uint64
```

```
            |  |  +--w cfg-mitigation-type string
            |  |  +--ro result-params
            |  |  |  (choice based on type )s
         |  +--output
         |  |  +--ro cloud-name string
            |  |  +--ro cloud-api-type identitref
         |  |  +--ro cloud-sec-id  uint64
            |  |  +--ro policy-id uint64
         |  |  +--ro cfg-mitigation boolean
            |  |  +--ro status identityref /reject, started, done
         |  |  +--ro cfg-mitigation-type
            |  |  +--ro result-params
            +--x reset opstate-counters
         |  +--input
         |  |  +--w cloud-name string
            |  |  +--w cloud-api-type identitref
         |  |  +--w cloud-sec-id  uint64
            |  |  +--w policy-id     uint64
         |  |  +--w request-identifier uint64
         |  +--output
         |  |  +--ro cloud-name string
            |  |  +--ro cloud-api-type identitref
         |  |  +--ro cloud-sec-id    uint64
            |  |  +--ro policy-id uint64
         |  |  +--ro request-identifier uint32
         |  |  +--ro stats-reset-id   uint64
```

3.1.6. notifications for Inter-Cloud Yang Module

This section describes the notifications that will be need to form the DDoS capabilities. However, these notifications are not yet in the yang module.

```
   notifications:
          +--n inter-cloud-capability-change
          |  ...
      +--n policy-change
      | ...
          +--n opstate-reset
          | ...
          +--n mitigation-failure
          | ..
```

3.2. Implementing inter-Cloud DDoS API with Yang module

The implementation of the actions requested in Inter-Cloud DDoS API ([I-D.fang-i2nsf-inter-cloud-ddos-mitigation-api]) are the followingL

query DDoS capabilities: API specifies query/response pair (per [I-D.fang-i2nsf-inter-cloud-ddos-mitigation-api] section 4.1) This is implemented with the GET in Yang module as requested in teh API. (per [I-D.fang-i2nsf-inter-cloud-ddos-mitigation-api] section 4.2.11)) The first thing a Cloud provider should query is the variable: Inter-Cloud-DDoS-capabilities/capability-query. If this value is true, then respondent provides cloud-capabilities entry with all the capabilities it will expose.

* RESTCONF: GET/GET-response with array of mitigation DDoS mitigation.

* NETCONF: GET/GET-response with array of mitigation

* Alternative 1: pub/sub subscription for DDoS capabilities after the initial get.

Mitigation: API specifies specifies action request/response pair on based on a a pre-arranged agreement that specifies a set of policy rules (per [I-D.fang-i2nsf-inter-cloud-ddos-mitigation-api], section 4.1.2 and section 4.2.2). This data model places the policy rules in the cfg-attack-mitigate-policy array indexed by a policy-id. The action request/response need to:

1. acknowledge the request

2. Execute a particular DDOS capability

3. second response with logged actions and mitigation status

The implementation of these functions are as follows;

* NETCONF/RESTCONF rpc "start-mitigation" provides the two responses based on activity. The rpc is described in the section below.

* RESTCONF functions of POST, GET, PUT, DELETE provide the add/change/delete functions for a particular policy cfg-attack-mitigate-policy indexed policy id.

* NETCONF get, edit-config, and delete provide the add/change/ delete functions for a particular policy cfg-attack-mitigate-policy indexed policy id.

* Addition 1: Allow pub/sub as a mechanism for a Cloud provider to provide notifications for policy opstate to remote Cloud provider I2NSF consumer.

* Addition 2: Allow pub/sub as a mechanism for Cloud provider to report changes in policy to remote cloud provicer

Monitor and Report Mitigation: The feature provides for the monitoring and reporting of the a particular DDOS mitigation (per [I-D.fang-i2nsf-inter-cloud-ddos-mitigation-api] section 4.1.3 and section 4.2.3). This yang module utilizes the mitigation-opstate which provides a list of operational state per mitigation policy-id. The "cloud-mitigate_opstate" grouping has a "stats-reset-id" that implements an indicator if the stats have been reset. If the stats have not been reset, the counters should be monitonically increasig. The operations to handle add/change/delete for the monitoring polcy are:

* RESTCONF POST, GET, PUT, and DELETE,

* NETCONF get, edit-config, and delete

* NETCONF pub/sub that indicate if the remote side has add/changed/deleted monitoring policy.

The operations to pull large amounts of monitoring data should utilize the pub/sub push facilities.

Knowledge sharing: Knowledge sharing looks to obtain remote Cloud Providers black list. This remote black list is part of the operational state retrieve (cloud-mitigate_opstate/knowledge-sharing). The knowledge-sharing capabilty indicates if the remote side supports this. The cfg-mitigate-monitoring grouping allows a policy to be configured to share-blacklist the black list.

4. Oveview of Other Yang Modules referenced

This section review the other yang modules used by this mode. This section is provided for informational purposes. In the final revision of this yang model this section should be removed.

4.1. Filter-Based RIB data model

The filter-based RIB [I-D.ietf-i2rs-fb-rib-data-model] stores policy for flow specification configured in a node, distributed by I2RS, and received or configured by BGP peers and installed in the kernel. It is used by this model to store BGP flow specification policy received

or locally configured so that it can be easily compared with other flow specification policy set in NSF devices.

Note: This section is provided for informational purposes. In the final revision of this yang model this section should be removed

The High level yang for the filter-based RIB
Augments rt:logical-network-elements:\
:logical-network-element:network-instances: \
network-instance

```
ietf-fb-rib module
  +--rw ietf-fb-rib
     +--rw default-instance-name string
     +--rw default-router-id rt:router-id
     +--rw config-fb-ribs
            if-feature "config-filter-based-RIB";
        uses fb-ribs;
     +--rw i2rs-fb-ribs
                 if-feature "I2RS-filter-based-RIB";
                 uses fb-rib-t:fb-ribs;
     +--rw bgp-fs-fb-ribs
                if-feature "BGP-FS-filter-based-RIB";
                 uses fb-rib-t:fb-ribs;

ietf-fb-rib module
  +--rw ietf-fb-rib-opstate
    +--rw default-instance-name string
    +--rw default-router-id rt:router-id
        +--rw config-fb-rib-opstate
                 if-feature "config-filter-based-RIB";
                 uses fb-rib-t:fb-ribs-oper-status;
        +--rw i2rs-fb-rib-opstate {
                 if-feature "I2RS-filter-based-RIB";
                 uses fb-rib-t:fb-ribs-oper-status;
        +--rw bgp-fs-fb-rib-opstate
                 if-feature "BGP-FS-filter-based-RIB";
                 uses fb-rib-t:fb-ribs-oper-status;
```

4.2. Packet ECA Policy

The packet eca policy yang model [I-D.ietf-i2rs-pkt-eca-data-model] is used by the filter-based RIB and the I2NSF capability model. The high level yang for this model is described below.

```
   module ietf-pkt-eca-policy
     +--rw pkt-eca-policy-cfg
     |  +--rw pkt-eca-policy-set
     |     +--rw groups* [group-name]
     |     |  +--rw group-name string
     |     |  +--rw vrf-name string
     |     |  +--rw address-family
     |     |  +--rw group-rule-list* [rule-name]
     |     |  |  +--rw rule-name
     |     |  |  +--rw rule-order-id
     |     |  |  +--rw default-action-id integer
     |     |  |  +--rw default-resolution-strategy-id integer
     |     +--rw rules* [order-id rule-name]
     |        +--rw order-id
     |        +--rw rule-name
     |        +--rw cfg-rule-conditions [cfgr-cnd-id]
     |        |  +--rw cfgr-cnd-id integer
     |        |  +--rw eca-event-match
     |        |  |  +--rw time-event-match*
     |        |  |  |   .. (time of day)
     |        |  +--rw eca-condition-match
     |        |  |  +--rw eca-pkt-matches*
     |        |  |  |  ... (L1-L4 matches)
     |        |  |  +--rw eca-user-matches*
     |        |  |  | (user, schedule, region, target,
     |        |  |  |     state, direction)
     |        +--rw cfg-rule-actions [cfgr-action-id]
     |        |  +--rw cfgr-action-id
     |        |  +--rw eca-actions* [action-id]
     |        |  |  +--rw action-id uint32
     |        |  |  +--rw eca-ingress-act*
     |        |  |  | ... (permit, deny, mirror)
     |        |  |  +--rw eca-fwd-actions*
     |        |  |  | ...  (invoke, tunnel encap, fwd)
     |        |  |  +--rw eca-egress-act*
     |        |  |  | .. .
     |        |  |  +--rw eca-qos-actions*
     |        |  |  | ...
     |        |  |  +--rw eca-security-actions*
     |        +--rw pc-resolution-strategies* [strategy-id]
     |        |  +--rw strategy-id integer
     |        |  +--rw filter-strategy identityref
     |        |  |  .. FMR, ADTP, Longest-match
     |        |  +--rw global-strategy identityref
     |        |  +--rw mandatory-strategy identityref
     |        |  +--rw local-strategy identityref
     |        |  +--rw resolution-fcn uint32
     |        |  +--rw resolution-value uint32
```

```
     |        |  +--rw resolution-info  string
     |        |  +--rw associated-ext-data*
     |        |  |  +--rw ext-data-id integer
     |        +--rw cfg-external-data* [cfg-ext-data-id]
     |        |  +--rw cfg-ext-data-id integer
     |        |  +--rw data-type integer
     |        |  +--rw priority uint64
     |        |  |  uses external-data-forms
     |        |  ... (other external data)
     +--rw pkt-eca-policy-opstate
        +--rw pkt-eca-opstate
           +--rw groups* [group-name]
           |  +--rw rules-installed;
           |  +--rw rules_status* [rule-name]
                    |  +--rw strategy-used [strategy-id]
                    |  +--rw
           +--rw rule-group-link* [rule-name]
           |  +--rw group-name
           +--rw rules_opstate* [rule-order rule-name]
           |  +--rw status
           |  +--rw rule-inactive-reason
           |  +--rw rule-install-reason
           |  +--rw rule-installer
           |  +--rw refcnt
           +--rw rules_op-stats* [rule-order rule-name]
           |  +--rw pkts-matched
           |  +--rw pkts-modified
           |  +--rw pkts-forward
                   +--rw op-external-data [op-ext-data-id]
                    |  +--rw op-ext-data-id integer
                    |  +--rw type identityref
                    |  +--rw installed-priority integer
                    |  |  (other details on external data )
```

4.3. Capability high level model

The following yang model is available in [I-D.hares-i2nsf-capability-yang] and references [I-D.ietf-i2rs-pkt-eca-data-model].

The High level yang for the data moel

```
ietf-i2nsf-capability
 +--rw nsf-capabilities
    +--rw capability* [name]
           +--rw nsf-name  string
           +--rw cfg-net-secctl-capabilities
       |  uses pkt-eca-policy:pkt-eca-policy-set
       +--rw cfg-net-sec-content-capabilities
           |  uses i2nsf-content-caps
           |  uses i2nsf-content-sec-actions
           +--rw cfg-attack-mitigate-capabilities*
           |  uses i2nsf-mitigate-caps
           +--rw ITResource [ITresource-name]
           |  uses cfg-ITResources
```

Figure 2: ietf-i2nsf-capabilities
High level yang structure

5. YANG Modules

TBD

6. IANA Considerations

TBD. This model will require URN assignment for yang module.

7. Security Considerations

Security concerns across-domain need to be discussed here.

8. References

8.1. Normative References

[I-D.fang-i2nsf-inter-cloud-ddos-mitigation-api]
Fang, L. and D. Bansal, "Inter-Cloud DDoS Mitigation API", draft-fang-i2nsf-inter-cloud-ddos-mitigation-api-01 (work in progress), March 2016.

[I-D.hares-i2nsf-capability-yang]
Hares, S. and R. Moskowitz, "I2NSF Capability Yang Model", draft-hares-i2nsf-capability-yang-00 (work in progress), July 2016.

[I-D.ietf-i2rs-fb-rib-data-model]
Hares, S., Kini, S., Dunbar, L., Krishnan, R., Bogdanovic, D., and R. White, "Filter-Based RIB Data Model", draft-ietf-i2rs-fb-rib-data-model-00 (work in progress), June 2016.

[I-D.ietf-i2rs-pkt-eca-data-model]
Hares, S., Wu, Q., and R. White, "Filter-Based Packet Forwarding ECA Policy", draft-ietf-i2rs-pkt-eca-data-model-00 (work in progress), June 2016.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <http://www.rfc-editor.org/info/rfc2119>.

[RFC6421] Nelson, D., Ed., "Crypto-Agility Requirements for Remote Authentication Dial-In User Service (RADIUS)", RFC 6421, DOI 10.17487/RFC6421, November 2011, <http://www.rfc-editor.org/info/rfc6421>.

8.2. Informative References

[I-D.ietf-i2nsf-gap-analysis]
Hares, S., Moskowitz, R., and D. Zhang, "Analysis of Existing work for I2NSF", draft-ietf-i2nsf-gap-analysis-00 (work in progress), February 2016.

[I-D.ietf-i2nsf-problem-and-use-cases]
Hares, S., Dunbar, L., Lopez, D., Zarny, M., and C. Jacquenet, "I2NSF Problem Statement and Use cases", draft-ietf-i2nsf-problem-and-use-cases-00 (work in progress), February 2016.

[I-D.ietf-i2nsf-terminology]
Hares, S., Strassner, J., Lopez, D., and L. Xia, "Interface to Network Security Functions (I2NSF) Terminology", draft-ietf-i2nsf-terminology-00 (work in progress), May 2016.

[I-D.ietf-i2rs-fb-rib-info-model]
Kini, S., Hares, S., Dunbar, L., Ghanwani, A., Krishnan, R., Bogdanovic, D., and R. White, "Filter-Based RIB Information Model", draft-ietf-i2rs-fb-rib-info-model-00 (work in progress), June 2016.

[I-D.ietf-netmod-acl-model]
Bogdanovic, D., Koushik, K., Huang, L., and D. Blair, "Network Access Control List (ACL) YANG Data Model", draft-ietf-netmod-acl-model-06 (work in progress), December 2015.

[I-D.ietf-opsawg-firewalls]
Baker, F. and P. Hoffman, "On Firewalls in Internet Security", draft-ietf-opsawg-firewalls-01 (work in progress), October 2012.

[I-D.xia-i2nsf-capability-interface-im]
Xia, L., Zhang, D., elopez@fortinet.com, e., Bouthors, N., and L. Fang, "Information Model of Interface to Network Security Functions Capability Interface", draft-xia-i2nsf-capability-interface-im-05 (work in progress), March 2016.

[I-D.xia-i2nsf-service-interface-dm]
Xia, L., Strassner, J., and D. Bogdanovic, "Data Model of Interface to Network Security Functions Service Interface", draft-xia-i2nsf-service-interface-dm-00 (work in progress), February 2015.

[RFC2975] Aboba, B., Arkko, J., and D. Harrington, "Introduction to Accounting Management", RFC 2975, DOI 10.17487/RFC2975, October 2000, <http://www.rfc-editor.org/info/rfc2975>.

[RFC3198] Westerinen, A., Schnizlein, J., Strassner, J., Scherling, M., Quinn, B., Herzog, S., Huynh, A., Carlson, M., Perry, J., and S. Waldbusser, "Terminology for Policy-Based Management", RFC 3198, DOI 10.17487/RFC3198, November 2001, <http://www.rfc-editor.org/info/rfc3198>.

[RFC3234] Carpenter, B. and S. Brim, "Middleboxes: Taxonomy and Issues", RFC 3234, DOI 10.17487/RFC3234, February 2002, <http://www.rfc-editor.org/info/rfc3234>.

[RFC3539] Aboba, B. and J. Wood, "Authentication, Authorization and Accounting (AAA) Transport Profile", RFC 3539, DOI 10.17487/RFC3539, June 2003, <http://www.rfc-editor.org/info/rfc3539>.

[RFC4949] Shirey, R., "Internet Security Glossary, Version 2", FYI 36, RFC 4949, DOI 10.17487/RFC4949, August 2007, <http://www.rfc-editor.org/info/rfc4949>.

[RFC7277] Bjorklund, M., "A YANG Data Model for IP Management", RFC 7277, DOI 10.17487/RFC7277, June 2014, <http://www.rfc-editor.org/info/rfc7277>.

Authors' Addresses

Susan Hares
Huawei
7453 Hickory Hill
Saline, MI 48176
USA

Phone: +1-734-604-0332
Email: shares@ndzh.com

Robert Moskowitz
HTT Consulting
Oak Park, MI
USA

Phone: +1-248-968-9809
Email: rgm@htt-consult.com