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SUPA Policy-based Management Framework
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Abstract

Simplified Use of Policy Abstractions (SUPA) defines base YANG data models to encode policy, which will point to device-, technology-, and service-specific YANG models developed in other working groups. Policy rules within an operator's environment can be used to express high-level, possibly network-wide policies to a network management function (within a controller, an orchestrator, or a network element). The network management function can then control the configuration and/or monitoring of network elements and services. This document describes the SUPA basic framework, its elements and interfaces.

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1. Introduction

The rapid growth in the variety and importance of traffic flowing over increasingly complex enterprise and service provider network architectures makes the task of network operations and management applications deploying new services much more difficult. In addition, network operators want to deploy new services quickly and efficiently. Two possible mechanisms for dealing with this growing difficulty are the use of software abstractions to simplify the design and configuration of monitoring and control operations, and the use of programmatic control over the configuration and operation of such networks. Policy-based management can be used to combine these two mechanisms into an extensible framework.

Policy rules within an operator's environment can be used to express high-level, possibly network-wide policies to a network management function (within a controller, an orchestrator, or a network element). The network management function can then control the configuration and/or monitoring of network elements and services.

Simplified Use of Policy Abstractions (SUPA) will define a generic policy information model (GPIM) [I-D.ietf-supa-generic-policy-info-model] for use in network operations and management applications. The GPIM defines concepts and terminology needed by policy management independent of the form and content of the policy rule. The ECA Policy Rule Information Model (EPRIM) [I-D.ietf-supa-generic-policy-info-model] extends the GPIM to define how to build policy rules according to the event-condition-action paradigm.

Both the GPIM and the EPRIM are targeted at controlling the configuration and monitoring of network elements throughout the service development and deployment lifecycle. The GPIM and the EPRIM will both be translated into corresponding YANG [RFC6020][RFC6020bis] modules that define policy concepts, terminology, and rules in a generic and interoperable manner; additional YANG modules may also be defined from the GPIM and/or EPRIM to manage specific functions.

The key benefit of policy management is that it enables different network elements and services to be instructed to behave the same way, even if they are programmed differently. Management applications will benefit from using policy rules that enable scalable and consistent programmatic control over the configuration and monitoring of network elements and services.

2. Terminology

GPIM: Generic Policy Information Model, which defines concepts and terminology needed by policy management independent of the form and content of the policy rule.

EPRIM: ECA Policy Rule Information Model, which extends the GPIM to define how to build policy rules according to the event-condition-action paradigm.

GPDM: Generic Policy Data Models [I-D.ietf-supa-generic-policy-data-model], are created from the GPIM. These YANG data model policies are used to control the configuration of network elements that model the service(s) to be managed using policy.

3. Framework for Generic Policy-based Management

This section briefly describes the design and operation of the SUPA policy-based management framework.

3.1. Overview

Figure 1 shows a simplified functional architecture of how SUPA is used to define policies for creating network element configuration snippets. (Note from Editor: a "snippet" is a small piece of information (e.g., part of a sentence that was cut out).) SUPA uses the GPIM to define a consensual vocabulary that different actors can use to interact with network elements and services. The EPRIM defines a generic structure for imperative policies. The GPIM, and/or the combination of the GPIM and the EPRIM, is converted to generic YANG data modules.

In one possible approach, SUPA Generic Policy and SUPA ECA Policy YANG data modules together with the Resource and Service YANG data models specified in IETF (which define the specific elements that will be controlled by policies) are used by the Service Interface Logic. This Service Interface Logic creates appropriate input mechanisms for the operator to define policies (e.g., a web form or a script) for creating and managing the network configuration. The operator interacts with the interface, which is then translated to configuration snippets.

Note that YANG models may not exist. In this case, the SUPA generic policy YANG data modules serve as an extensible basis to develop new YANG data models for the Service Interface Logic to create appropriate input mechanisms for the operator to define policies. This transfers the work specified by the Resource and Service YANG data models specified in IETF into the Service Interface Logic, which is then translated to configuration snippets.

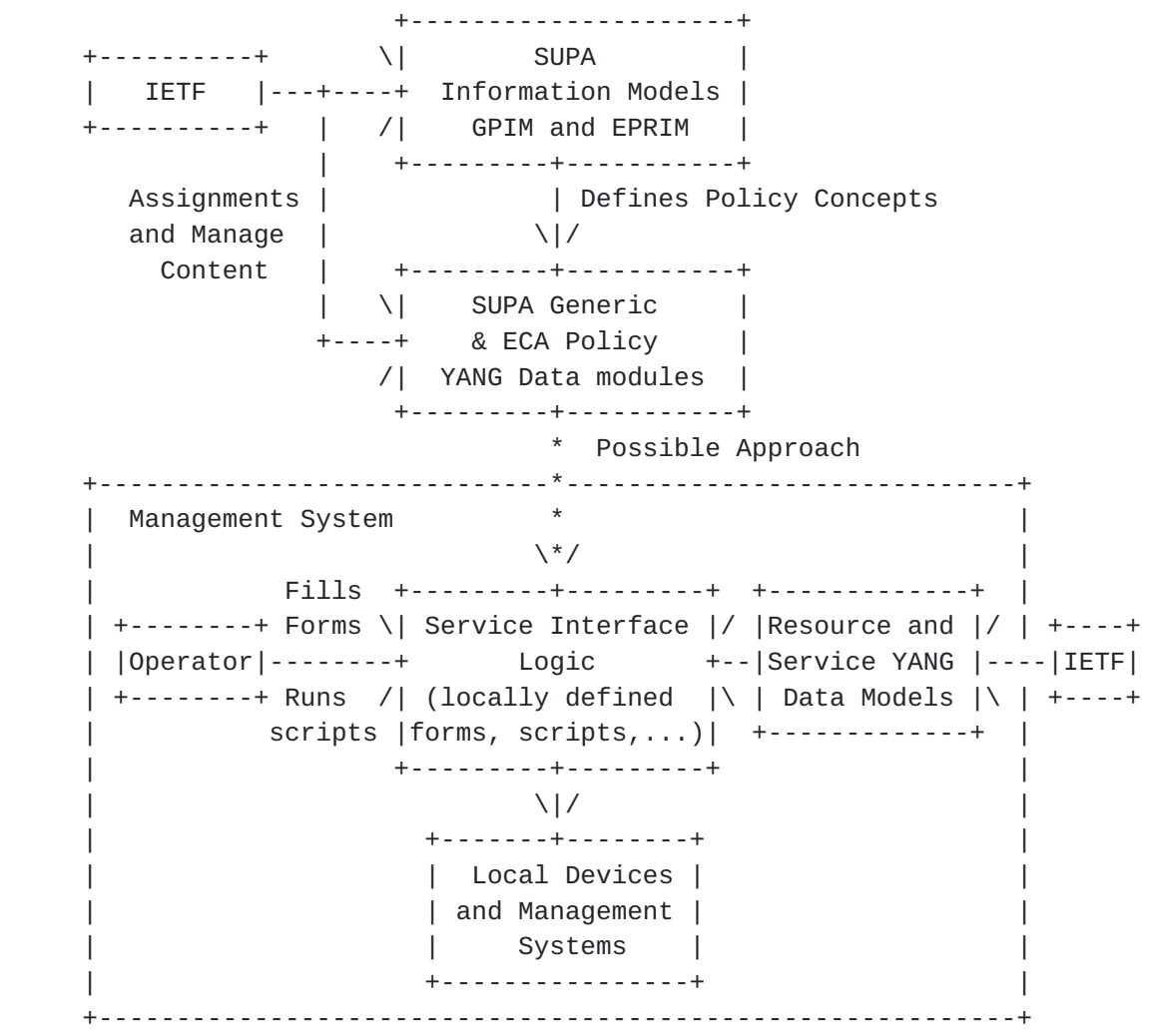

Figure 1: SUPA Framework

Figure 1 is exemplary. The Operator actor shown in Figure 1 can interact with SUPA in other ways not shown in Figure 1. In addition, other actors (e.g., an application developer) that can interact with SUPA are not shown for simplicity.

The EPRIM defines an Event-Condition-Action (ECA) policy as an example of imperative policies. An ECA policy rule is activated when its event clause is true; the condition clause is then evaluated and, if true, signals the execution of one or more actions in the action clause. This type of policy explicitly defines the current and desired states of the system being managed. Imperative policy rules require additional management functions, which are explained in section 2.2 below.

Figure 2 shows how the SUPA Policy Model is used to create policy data models step by step and how the policy rules are used to

communicate among various network management functions located on different layers.

The Generic Policy Information Model (GPIM) is used to construct policies. The GPIM defines generic policy concepts, as well as two types of policies: ECA policy rules and declarative policy statements.

A set of Generic Policy Data Models (GPDM) are then created from the GPIM. These YANG data model policies are then used to control the configuration of network elements that model the service(s) to be managed using policy.

SUPA designed YANG data models can be the input for management functions, and automatically generate interfaces and data stores. During the run time, components communicate with the data instances for management and monitoring.

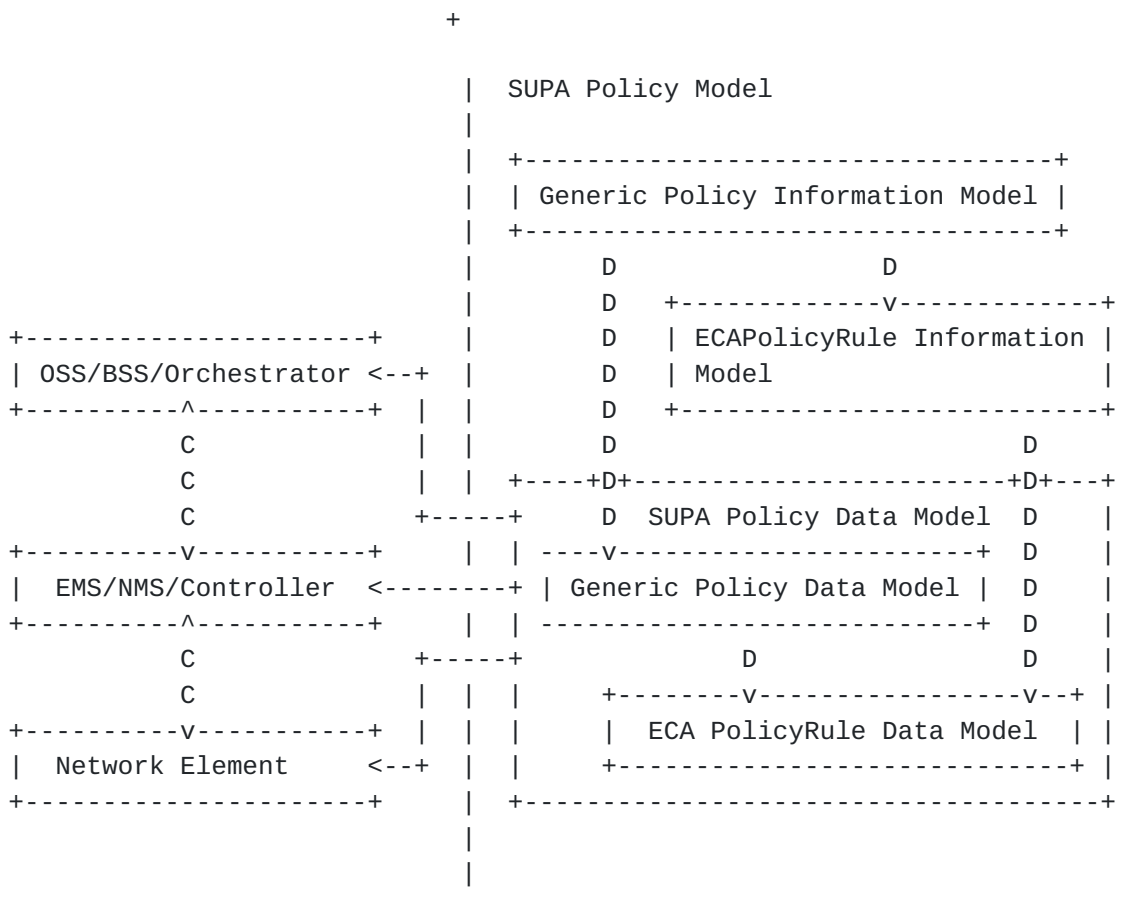

Figure 2: SUPA Policy Model Framework

In Figure 2:

The double-headed arrow with Cs means communication;

The arrow with Ds means derived from.

The components within this framework are:

SUPA Policy Model: represents one or more policy modules that contain the following entities:

Generic Policy Information Model: a model for defining policy rules that are independent of data repository, data definition, query, implementation languages, and protocol. This model is abstract and is used for design; it MUST be turned into a data model for implementation.

Generic Policy Data Model: a model of policy rules that are dependent on data repository, data definition, query, implementation languages, and protocol.

ECA Policy Rule Information Data Model (EPRIM): represents a policy rule as a statement that consists of an event clause, a condition clause, and an action clause. This type of Policy Rule explicitly defines the current and desired states of the system being managed. This model is abstract and is used for design; it MUST be turned into a data model for implementation.

ECA Policy Rule Data Model: a model of policy rules, derived from EPRIM, that consist of an event clause, a condition clause, and an action clause.

EMS/NMS/Controller: represents one or more entities that are able to control the operation and management of a network infrastructure (e.g., a network topology that consists of Network Elements).

Network Service and Resource Data Models: models of the service as well as physical and virtual network topology including the resource attributes (e.g., data rate or latency of links) and operational parameters needed to support service deployment over the network topology.

Network Element (NE), which can interact with local or remote EMS/NMS/Controller in order to exchange information, such as configuration information, policy enforcement capabilities, and network status.

Relationship between Policy, Service and Resource models can be illustrated by the figure below.

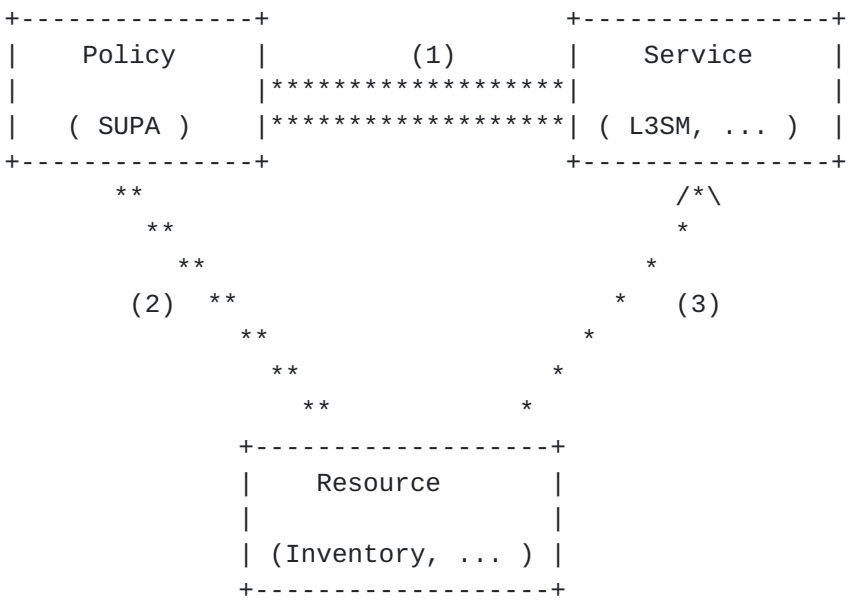

Figure 3: Relationship between Policy, Service and Resource models

In Figure 3:

(1) policy manages and can adjust service behavior as necessary (1:1..n)
(2) policy manages and can adjust resource behavior as necessary (1:1..n)
(3) resource hosts service; changing resources may change service behavior as necessary

Policies are used to control the management of resources and services, while data from resources and services are used to select and/or modify policies during runtime. More importantly, policies can be used to manage how resources are allocated and assigned to services. This enables a single policy to manage one or multiple services and resources as well as their dependencies. (1:1..n) in (1) and (2) below figure 3 shows one policy rule is able to manages and can adjust one or multiple services/resources. Line (1) and (2) connecting policy to resource and policy to service are same, and line (3) connecting resource to service is different as it's navigable only from resource to service.

3.2. Operation

SUPA can be used to define various types of policies, including policies that affect services and/or the configuration of individual or groups of network elements. SUPA can be used by a centralized and/or distributed set of entities for creating, managing, interacting with, and retiring policy rules.

The SUPA scope is limited to policy information and data models. SUPA will not define network resource data models or network service data models; both are out of scope. Instead, SUPA will make use of network resource data models defined by other WGs or SDOs.

Declarative policies that specify the goals to be achieved but not how to achieve those goals (also called "intent-based" policies) are out of scope for the initial phase of SUPA.

3.3. The GPIM and the EPRIM

The GPIM provides a common vocabulary for representing concepts that are common to expressing different types of policy, but which are independent of language, protocol, repository, and level of abstraction. Hence, the GPIM defines concepts and vocabulary needed by policy management systems independent of the form and content of the policy. The ERPIM is a more specific model that refines the GPIM to specify policy rules in an event-condition-action form.

This enables different policies at different levels of abstraction to form a continuum, where more abstract policies can be translated into more concrete policies, and vice-versa. For example, the information model can be extended by generalizing concepts from an existing data model into the GPIM; the GPIM extensions can then be used by other data models.

3.4. Creation of Generic YANG Modules

An information model is abstract. As such, it cannot be directly instantiated (i.e., objects cannot be created directly from it). Therefore, both the GPIM and the combination of the GPIM and the EPRIM, are translated to generic YANG modules.

SUPA will provide guidelines for translating the GPIM (or the combination of the GPIM and the EPRIM) into concrete YANG data models that define how to manage and communicate policies between systems. Multiple imperative policy YANG data models may be instantiated from the GPIM (or the combination of the GPIM and the EPRIM). In particular, SUPA will specify a set of YANG data models that will consist of a base policy model for representing policy management concepts independent of the type or structure of a policy, and as well, an extension for defining policy rules according to the ECA paradigm.(Note from Editor: This means that policies can be defined using the GPIM directly, or using the combination of the GPIM and the EPRIM. If you use only the GPIM, you get a technology- and vendor-independent information model that you are free to map to the data model of your choice; note that the structure of a policy is NOT defined. If you use the GPIM and the EPRIM, you get a technology-

and vendor-independent information model that defines policies as an event-condition-action (i.e., imperative) rule.)

The process of developing the GPIM, EPRIM and the derived/translated YANG data models is realized following the sequence shown below. After completing this process and if the implementation of the YANG data models requires it, the GPIM and EPRIM and the derived/ translated YANG data models are updated and synchronized.

(1)=>(2)=>(3)=>(4)=>(3')=>(2')=>(1')

Where, (1)=GPIM; (2)=EPRIM; (3)=YANG data models; (4)= Implementation; (3')= update of YANG data models; (2')=update of EPRIM; (1') = update of GPIM

The YANG module derived from the GPIM contains concepts and terminology for the common operation and administration of policy-based systems, as well as an extensible structure for policy rules of different paradigms. The YANG module derived from the EPRIM extends the generic nature of the GPIM to represent policies using an event-condition-action structure.

The above sequence allows for the addition of new, as well as the editing of existing model elements in the GPIM and EPRIM. In practice, the implementation sequence may be much simpler. Specifically, it is unlikely that the GPIM will need to be changed. In addition, changes to the EPRIM will likely be focused on fine-tuning the behavior offered by a specific set of model elements.

4. Security Considerations

TBD

5. IANA Considerations

This document has no actions for IANA.

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