Network Working Group   W. Liu
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Expires: March 31, 2018   China Telecom
                                                             J. Strassner
                                                          G. Karagiannis
                                                      Huawei Technologies
                                                                M. Klyus
                                                              NetCracker
                                                                   J. Bi
                                                      Tsinghua University
                                                                Y. Cheng
                                                             China Unicom
                                                                D. Zhang
                                                      Huawei Technologies
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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 point to device-, technology-, and
   service-specific YANG models developed elsewhere. 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.

Status of This Memo

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

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1. Introduction

Traffic flows over increasingly complex enterprise and service
provider networks become more and more important. Meanwhile, the
rapid growth of the variety makes the task of network operations and
management applications deploying new services much more difficult.
Moreover, 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 are a set of rules that define how services are designed, delivered, and operated. The SUPA (Simplified Use of Policy Abstractions) data model represents high-level, possibly network-wide policy, which can be input 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 according to such policies.

SUPA defines 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 Event-Condition-Action (ECA) Policy Rule Information Model (EPRIM) [I-D.ietf-supa-generic-policyinfo-model] extends the GPIM by defining 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 can 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 derived 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.

Some typical and useful instances, for authors to understand the applicability of SUPA, such as SNMP blocking upon load of link reaching a threshold, virtual maching migration upon the changinng of user location, are written in [I-D.cheng-supa-applicability].

2. Terminology

SUPA: Simplified Use of Policy Abstractions, is the working group name, which defines a data model, to be used to represent high-level, possibly network-wide policies, which can be input to a network management function (within a controller, an orchestrator, or a network element).

YANG: an acronym for "Yet Another Next Generation". YANG is a data modeling language used to model configuration and state data

manipulated by the Network Configuration Protocol (NETCONF), NETCONF remote procedure calls, and NETCONF notifications.[RFC6020]

ECA: Event-Condition-Action, is a short-cut for referring to the structure of active rules in event driven architecture and active database systems.

EMS: Element Management System, software to monitor and control network elements (devices) in telecommunications.

NMS: Network Management System, a set of hardware and/or software tools that allow an IT professional to supervise the individual components of a network within a larger network management framework.

OSS: Operations/Operational Support System, are computer systems used by telecommunications service providers to manage their networks (e.g., telephone networks).

BSS: Business Support Systems, are used to support various end-to-end telecommunication services.

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 by defining 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. The relationship of information model (IM) and DM can be founded in [RFC3444].

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

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 (shown with asterisks in Figure 1), 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,
   the policies input by operators are then translated to configuration
   snippets.

   Note that the Resource and Service 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 This transfers the work specified by the Resource and
   Service YANG data models specified in IETF into the Service Interface
   Logic.

```
                           +---------------------+
       +----------+      \|        SUPA         |
       |   IETF   |---+----+  Information Models |
       +----------+   |   /|    GPIM and EPRIM   |
                      |    +---------+-----------+
          Assignments |              | Defines Policy Concepts
          and Manage  |             \|/
            Content   |    +---------+-----------+
                      |  \|    SUPA Generic      |
                    +----+    & ECA Policy       |
                        /|   YANG Data modules   |
                         +---------+-----------+
                               *  Possible Approach
     +----------------------------*----------------------------+
     |  Management System         *                            |
     |                           \*/                           |
     |           Fills  +---------+---------+  +-------------+  |
     | +--------+ Forms \| Service Interface |/ |Resource and |/ | +----+
     | |Operator|--------+       Logic       +--|Service YANG |----|IETF|
     | +--------+ Runs  /| (locally defined  |\ | Data Models |\ | +----+
     |          scripts |forms, scripts,...)|  +-------------+  |
     |                  +---------+---------+                   |
     |                         \|/                             |
     |                 +-------+--------+                       |
     |                 | Local Devices  |                       |
     |                 | and Management |                       |
     |                 |    Systems     |                       |
     |                 +----------------+                       |
     +---------------------------------------------------------+
```
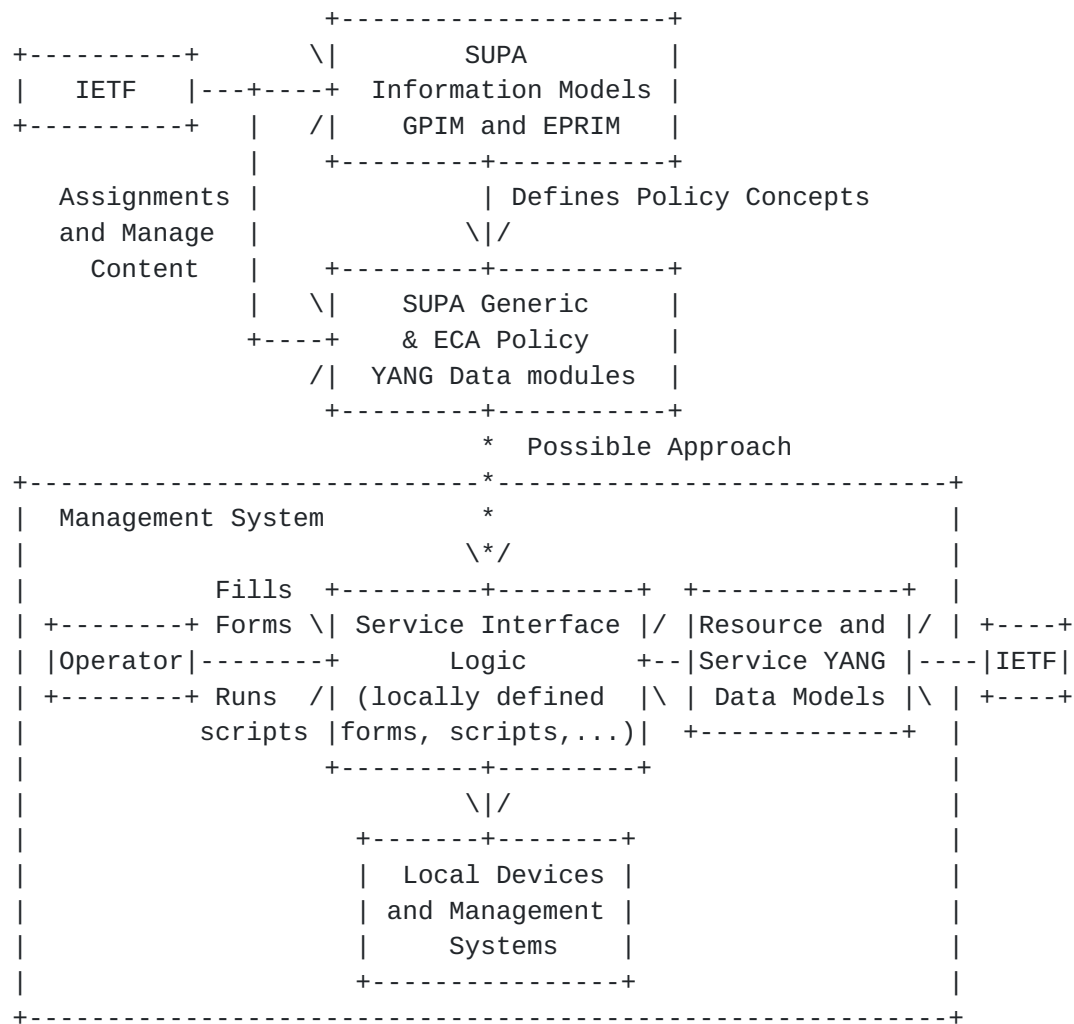
                      Figure 1: SUPA Framework

   Figure 1 is exemplary. The Operator actor 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 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 3.2 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.

Resource and Service YANG 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.

```
                                |  SUPA Policy Model
                                |
                                |  +----------------------------------+
                                |  | Generic Policy Information Model  |
                                |  +----------------------------------+
                                |        D                   D
                                |        D    +-------------v-------------+
+----------------------+        |        D    |     ECA Policy Rule       |
| OSS/BSS/Orchestrator <--+     |        D    |     Information Model      |
+----------^-----------+  |  |  |        D    +---------------------------+
           C             |  |        D                          D
           C             |  | +----+D+------------------------+D+---+
           C           +-----+     D  SUPA Policy Data Model  D   |
+----------v-----------+  | | ----v-----------------------+  D   |
|  EMS/NMS/Controller  <--------+ | Generic Policy Data Model |  D   |
+----------^-----------+  | | ---------------------------+  D   |
           C           +-----+            D                  D   |
           C             | | |   +---------v----------------v--+ |
+----------v-----------+  | | |   |  ECA Policy Rule Data Model  | |
|  Network Element   <--+ | |   +------------------------------+ |
+----------------------+     |  +------------------------------------+
                                |
                                |
```
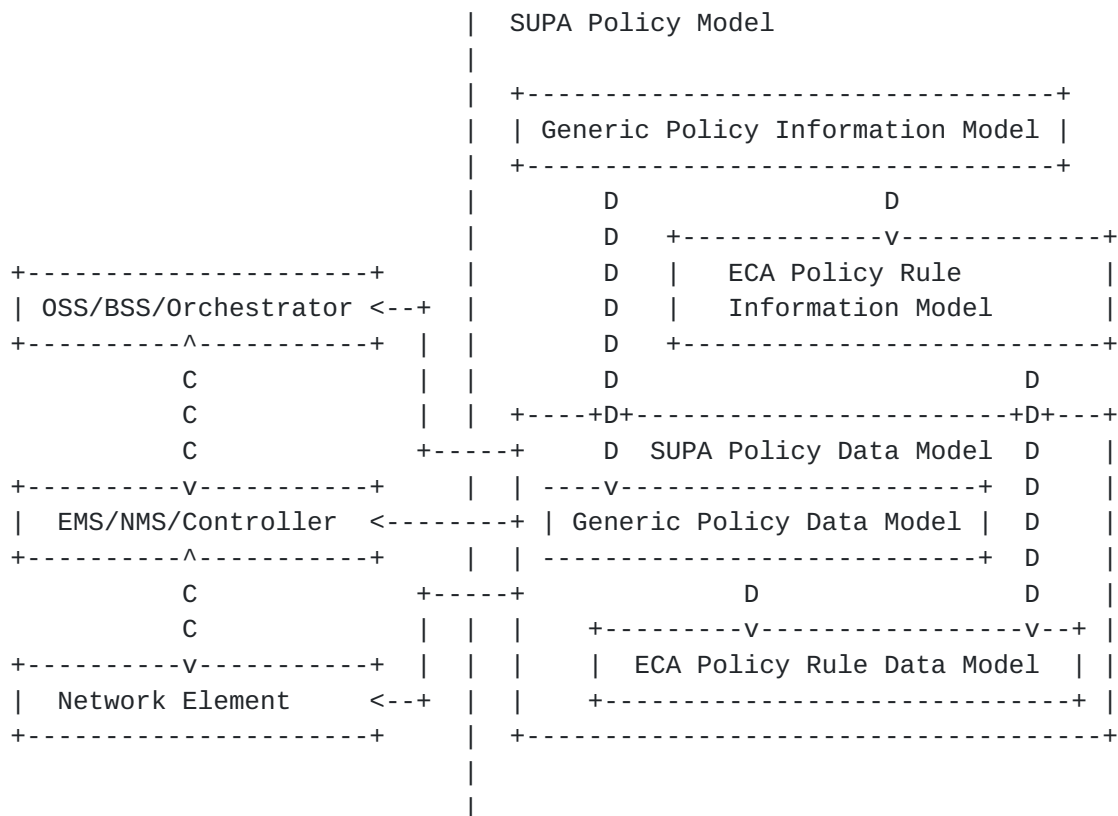
Figure 2: SUPA Policy Model Framework

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 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, while each policy rule consists 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 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.
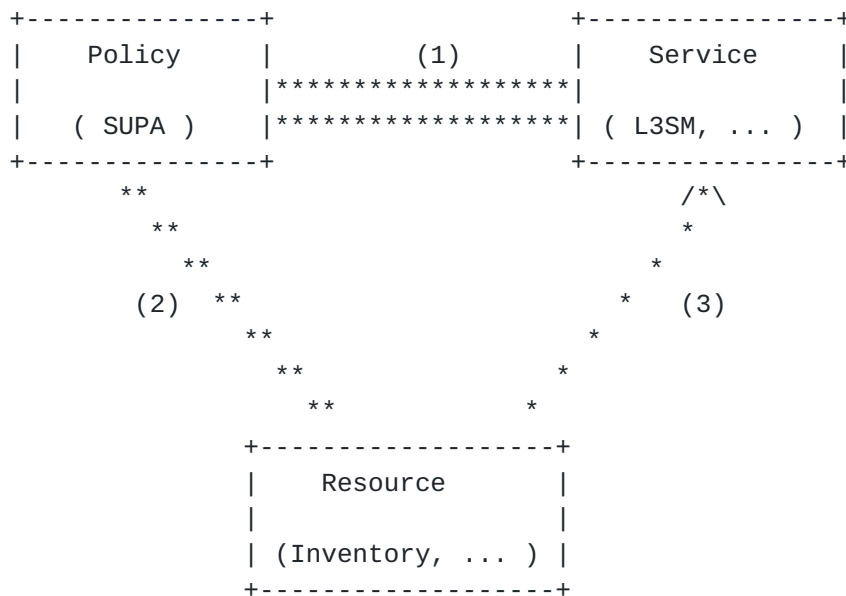
```
         +---------------+                   +----------------+
         |    Policy     |        (1)         |    Service     |
         |               |*****************|                  |
         |   ( SUPA )    |*****************| ( L3SM, ... )   |
         +---------------+                   +----------------+
              **                                     /*\
                **                                    *
                  **                                  *
              (2)   **                            *    (3)
                      **                         *
                        **                      *
                          **                   *
                            **                *
            +-------------------+
            |     Resource      |
            |                   |
            | (Inventory, ... ) |
            +-------------------+
```

   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). In addition, data from resources and services are used
      to select and/or modify policies during runtime.
      (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 show 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 the 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 does not define network resource data models or network service
data models; both are out of scope. Instead, SUPA makes use of
network resource data models defined by other WGs or SDOs.

Declarative 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 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 EPRIM
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 by representing 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

This informational document presents the framework and workflow of
SUPA, as well as an explanation on the relationship of policy,
service and resources. This document does not introduce any new
security issues, and the framework has no security impact on the
Internet. The same considerations are relevant as those for the base
NETCONF protocol (see Section 9 in [RFC6241]).

5. IANA Considerations

This document has no actions for IANA.

6. Contributors

The following people all contributed to creating this document,
listed in alphabetical order:

         Ying Chen, China Unicom
         Luis M. Contreras, Telefonica I+D
         Dan Romascanu, Avaya
         Juergen Schoenwaelder, Jacobs University, Germany
         Qiong Sun, China Telecom

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   The following people all contributed to creating this document,
   listed in alphabetical order:

      Vikram Choudhary, Huawei Technologies
      Luis M. Contreras, Telefonica I+D
      Dan Romascanu, Avaya
      Juergen Schoenwaelder, Jacobs University, Germany
      Qiong Sun, China Telecom
      Parviz Yegani, Juniper Networks

   This document has benefited from reviews, suggestions, comments and
   proposed text provided by the following members, listed in
   alphabetical order: H. Rafiee, J. Saperia and C. Zhou.

   The authors of "SUPA Value Proposition" [I-D.klyus-supa-value-
   proposition] were:

      Maxim Klyus, Ed. , NetCracker
      John Strassner, Ed. , Huawei Technologies
      Will(Shucheng) Liu, Huawei Technologies
      Georgios Karagiannis, Huawei Technologies
      Jun Bi, Tsinghua University

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   From "Problem Statement for Simplified Use of Policy Abstractions
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Authors' Addresses

   Will(Shucheng) Liu
   Huawei Technologies
   Bantian, Longgang District
   Shenzhen 518129
   China

   Email: liushucheng@huawei.com

   Chongfeng Xie
   China Telecom
   China Telecom Information Technology Innovation Park
   Beijing 102209
   China

   Email: xiechf.bri@chinatelecom.cn

   John Strassner
   Huawei Technologies
   2330 Central Expressway
   Santa Clara 95138
   CA USA

   Email: john.sc.strassner@huawei.com

Georgios Karagiannis
Huawei Technologies
Hansaallee 205
Dusseldorf 40549
Germany

Email: Georgios.Karagiannis@huawei.com

Maxim Klyus
NetCracker
Kozhevnicheskaya str.,7 Bldg. #1
Moscow
Russia

Email: klyus@netcracker.com

Jun Bi
Tsinghua University
Network Research Center, Tsinghua University
Beijing 100084
China

Email: junbi@tsinghua.edu.cn

Ying Cheng
China Unicom
No.21 Financial Street, XiCheng District
Beijing 100033
China

Email: chengying10@chinaunicom.cn

Dacheng Zhang
Huawei Technologies
Beijing
China

Email: dacheng.zhang@huawei.com