                       YANG Model Classification
                draft-ietf-netmod-yang-model-classification-01

Abstract

   The YANG [RFC6020] data modeling language is currently being
   considered for a wide variety of applications throughout the
   networking industry at large. Many standards-defining organizations
   (SDOs), open source software projects, vendors and users are using
   YANG to develop and publish models of configuration, state data and
   operations for a wide variety of applications. At the same time,
   there is currently no well-known terminology to categorize various
   types of YANG models.

   A consistent terminology would help with the categorization of
   models, assist in the analysis the YANG data modeling efforts in the
   IETF and other organizations, and bring clarity to the YANG-related
   discussions between the different groups.

   This document describes a set of concepts and associated terms to
   support consistent classification of YANG models.

Status of This Memo

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1. Introduction

   The Internet Engineering Steering Group (IESG) has been actively
   encouraging IETF working groups to use the NETCONF [RFC6241] and YANG
   standards for configuration management purposes, especially in new
   working group charters [Writable-MIB-Module-IESG-Statement].

   YANG is also gaining wide acceptance as the de-facto standard

modeling language in the broader industry. This extends beyond the
IETF, including many standards development organizations, industry
consortia, ad hoc groups, open source projects, vendors, and end-
users.

There are currently no clear guidelines on how to classify the
layering of YANG models according to abstraction, or how to classify
models along the continuum spanning formal standards publications,
vendor-specific models and models provided by end-users.

This document presents a set of concepts and terms to form a useful
taxonomy for consistent classification of YANG models in two
dimensions:

o The layering of models based on their abstraction levels

o The type of model based on the nature and intent of the content

The two categories are covered in the next two sections.

2. First Dimension: YANG Model Abstraction Layers

Model developers have taken two approaches to developing YANG models:
top-down and bottom-up. The top-down approach starts with high level
abstractions modeling business or customer requirements and maps them
to specific networking technologies. The bottom-up approach starts
with fundamental networking technologies and maps them into more
abstract constructs.

There are currently no specific requirements on, or well-defined best
practices around the development of models. For the purpose of this
document we assume that both approaches (bottom-up and top-down) will
be used as they both provide benefits that appeal to different
groups.

For layering purposes, this document suggests the classification of
data models into two distinct abstraction layers:

o Network Element YANG Models describe the configuration, state data
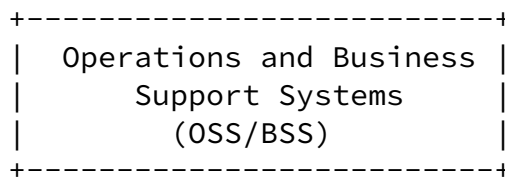   and operations of specific device-centric technologies or features

o   Network Service YANG Models describe the configuration, state data
    and operations of an abstract representation of a service
    implemented on one or multiple network elements

Figure 1 illustrates the application of YANG models at different
layers of abstraction. Layering of models allows for reusability of
existing lower layer models by higher level models while limiting
duplication of features across layers.

For model developers, per-layer modeling allows for separation of
concern across editing teams focusing on specific areas.

As an example, experience from the IETF shows that creating useful
network element YANG models for e.g. routing or switching protocols
requires teams that include developers with experience of
implementing those protocols.

On the other hand, network service models are best developed by
people experienced in defining network services for consumption by
programmers developing e.g. flow-through provisioning systems or
self-service portals.

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                    +--------------------------+
                    |  Operations and Business |
                    |      Support Systems     |
                    |         (OSS/BSS)        |
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        Network Service YANG data models


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            |  - VPWS   |      |  - VPLS    |      |    L3VPN   |
            |  - L2VPN  |      |  - L2VPN   |      |            |
            |           |      |            |      |            |
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        Network Element YANG data models
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|           |  |           |  |            |  |            |
|   MPLS    |  |    BGP    |  | IPv4 & IPv6|  |  Ethernet  |
|           |  |           |  |            |  |            |
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```
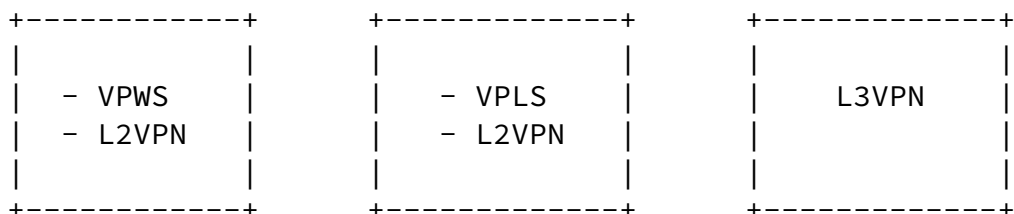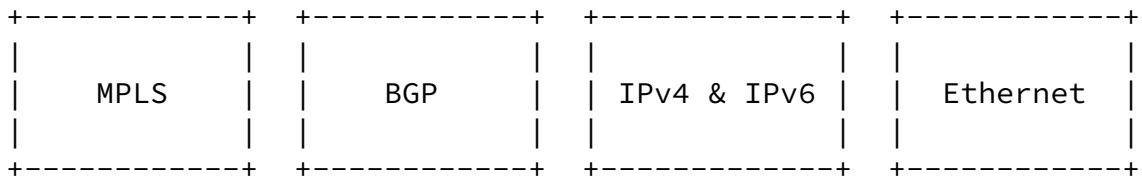
          Fig. 1 YANG Model Layers

2.1. Network Service YANG Data Models

   Network Service YANG Data Models describe the characteristics of a
   service, as agreed upon with consumers of that service. That is, a
   service model does not expose the detailed configuration parameters
   of all participating network elements and features, but describes an
   abstract model that allows instances of the service to be decomposed
   into instance data according to the Network Element data models of
   the participating network elements. The service-to-element

   decomposition is a separate process with details depending on how the
   network operator chooses to realize the service. For the purpose of
   this document we will use the term "orchestrator" to describe a
   system implementing such a process.

   As an example, the Network Service model included in
   [YANG-Data-Model-for-L3VPN-service-delivery] provides an abstracted
   model for Layer 3 IP VPN service configuration. An orchestrator
   receives operations on service instances according to the service
   model and decomposes the data into specific Network Element models to
   configure the participating network elements to perform the intent of
   the service.

   Network Service YANG models define services models to be consumed by
   external systems. These models are commonly designed, developed and
   deployed by network infrastructure teams.

   YANG allows for different design patterns to describe network
   services, ranging from monolithic to component-based approaches.

   The monolithic approach captures the entire service in a single model
   and does not put focus on reusability of internal data definitions

and groupings. The monolithic approach has the advantages of single-
purpose development including speed at the expense of reusability.

The component-based approach captures device-centric features (e.g.
the definition of a VRF, routing protocols, or packet filtering) in a
vendor-independent manner. The components are designed for reuse
across many services. The set of components required for a specific
service is then composed into the higher-level service. The
component-based approach has the advantages of modular development
including a higher degree of reusability at the expense of initial
speed.

As an example, an L2VPN service can be built on many different types
of transport network technologies, including e.g. MPLS or carrier
ethernet. A component-based approach would allow for reuse of e.g.
UNI-interface definitions independent of the underlying transport
network (e.g. MEF UNI interface or MPLS interface). The monolithic
approach would assume a specific set of transport technologies and
interface definitions.

2.2. Network Element YANG Data models

Network Element YANG Data Models describe the configuration, state
data and operations of a network device as defined by the vendor of
that device. The models are commonly structured around features of
the device, e.g. interface configuration [RFC7223], OSPF

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configuration [I-D.ietf-ospf-yang], and firewall rules definitions
[I-D.ietf-netmod-acl-model]. The model provides a coherent data
model representation of what is commonly a very mixed software
environment consisting of the operating system and applications
running on the device.

The decomposition, ordering, and execution of changes to the
operating system and application configuration is the task of the
management framework that implements the YANG model.

3. Second Dimension: Model Types

This document suggests classifying YANG model types as either
standard YANG models, vendor-specific YANG models and extensions, and
user-specific YANG models and extensions

The suggested classification applies to both Network Element YANG
Data Models and Network Service YANG Data Models.

It is to be expected that real-world implementations of both Network
Service and Network Element models will include a mix of all three
types of models.

3.1. Standard YANG Models

Standard YANG models are published by standards-defining
organizations (SDOs). While there is no formal definition of what
construes an SDO, a common feature is that they publish
specifications along specific processes with content that reflects
some sort of membership consensus. The specifications are developed
for wide use among the membership or for audiences beyond that.

The lifecycle of these models is driven by the editing cycle of the
specification and not tied to a specific implementation.

Examples of SDOs in the networking industry are the IETF, the IEEE
and the MEF.

3.2. Vendor-specific YANG Models and Extensions

Vendor-specific YANG models are developed by organizations with the
intent to support a specific set of implementations under control of
that organization. The intent of these models range from providing
openly published YANG models that may eventually be contributed back
to, or adopted by an SDO, to strictly internal YANG models not
intended for external consumption.

The lifecycle of these models are generally aligned with the release
cycle of the product or open source software project deliverables.

It is worth noting that there is an increasing amount of interaction
between open source projects and SDOs in the networking industry.
This includes open source projects implementing published standards
as well as open source projects contributing content to SDO
processes.

Vendors also develop Vendor-specific Extensions to standard models
using YANG constructs for extending data definitions of previously
published models. This is done using the 'augment' statement that
allows locally defined data trees to be augmented into locations in
externally defined data trees.

Vendors use this to extend standard data models to cover the full
scope of features in implementations, which commonly is broader than
what is covered by the standard model.

3.3. User-specific YANG Models and Extensions

User-specific YANG models are developed by organizations that operate
YANG-based infrastructure including devices and orchestrators. The
intent of these models is to express the specific needs for a certain
implementation, above and beyond what is provided by vendors.

This model type obviously requires the infrastructure to support the
introduction of user-provided models and extensions. This would
include ability to describe the service-to-network decomposition in
orchestrators and the model to configuration decomposition in
devices.

The lifecycle of these models are generally aligned with the change
cadence of the infrastructure.

3.4. Adding Models to Catalogs

The suggested classification in this document supports the creation
of catalogs, such as proposed in
[I-D.openconfig-netmod-model-catalog]. Such catalogs allows for easy
lookup and reusability of YANG models. SDO-classified models also
provide an educational resource providing architectural guidelines
for model development, based on a membership reviewn and consensus.

3.5. Security Considerations

At this stage, authors of the draft didn't look into security
   considerations.

3.6. IANA Considerations

   This document requests no action by IANA.

3.7. Acknowledgements

   Thanks to David Ball and David Hansford for feedback and suggestions.

3.8. Change log [RFC Editor: Please remove]

   version 00: Renamed and small fixes based on WG feedback.

   version 01: Language fixes, collapsing of vendor models and
   extensions, and the introduction of user models and extensions.

   version 02: Added two sections, Model Catalog and Benefits of model
   classification.

4. References

4.1. Normative References

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