ETSI GS NFV-SOL 006 V2.6.1 (2019-06)

Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; NFV descriptors based on YANG Specification

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Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Network Functions Virtualisation (NFV).

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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1 Scope

The present document specifies the YANG models for representing Network Functions Virtualisation (NFV) descriptors, fulfilling the requirements specified in ETSI GS NFV-IFA 011 [1] and ETSI GS NFV-IFA 014 [2] applicable to a Virtualised Network Function Descriptor (VNFD), a Physical Network Functions Descriptor (PNFD) and a Network Service Descriptor (NSD).

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI GS NFV-IFA 011 (V2.1.1): "Network Functions Virtualisation (NFV); Management and Orchestration; VNF Packaging Specification".

[2] ETSI GS NFV-IFA 014 (V2.1.1): "Network Functions Virtualisation (NFV); Management and Orchestration; Network Service Templates Specification".

[3] IETF RFC 7950: "The YANG 1.1 Data Modeling Language".

NOTE: Available at https://tools.ietf.org/html/rfc7950.

[4] IETF RFC 7951: "JSON Encoding of Data Modeled with YANG".

NOTE: Available at https://tools.ietf.org/html/rfc7951.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] IETF RFC 6241: "Network Configuration Protocol (NETCONF)".

NOTE: Available at https://tools.ietf.org/html/rfc6241.

[i.2] IETF RFC 8040: "RESTCONF Protocol".

NOTE: Available at https://tools.ietf.org/html/rfc8040.

[i.3] IETF RFC 8340: "YANG Tree Diagram".

NOTE: Available at https://tools.ietf.org/html/rfc8340.

[i.4] ETSI GS NFV-SOL 001: "Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; NFV descriptors based on TOSCA specification".

[i.5] ETSI GS NFV 003: "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI GS NFV 003 [i.5] apply.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI GS NFV 003 [i.5] and the following apply:

ASA	Adaptive Security Appliance
CSR	Cloud Service Router
DPI	Deep Packet Inspection
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
JSON	JavaScript Object Notation
REST	Representational State Transfer
RPC	Remote Procedure Call
URL	Uniform Resource Locator

4 Overview of YANG model

4.1 General

The YANG data modelling language is defined in IETF RFC 7950 [3]. The YANG language is used to model configuration and state data. IETF RFC 7950 [3] states that the data model represented by YANG is meant to be manipulated by the Network Configuration Protocol (NETCONF) [i.1]. Since IETF RFC 7950 [3] was written HTTP REST based protocols such as IETF RFC 8040 (RESTCONF) [i.2] have been specified and adopted for use with YANG based models.

4.2 Conventions

There are some common YANG practices that dictate the naming convention in the model. First of all, YANG does not use camel case in its naming. Instead it uses kebab-case, also known as lisp-case or cobol-case naming convention. Therefore an attribute in the information model like defaultLocalizationLanguage would be represented as default-localization-language in the YANG model

The second thing about the YANG language is that it is hierarchical in nature. The top level container therefore represents the parent for all the child nodes underneath it. Therefore, there is no need to repeat the name of the parent in the child node. A child node vnfd-element-group-id in the parent container vnfd-element-group would simply be renamed as id. Multiple entries of a certain attribute will be represented as list or leaf-list. To identify an entry in such a list requires a key. A key in general is named as "id". Therefore all such identifiers have been renamed as "id" in the model.

5 General concept of using YANG to model NFV descriptors

5.1 Introduction

A NFV descriptor (VNFD, PNFD or NSD) is modelled using the YANG models defined in the present document and then encoded as JSON text using the using the procedures specified in IETF RFC 7951 [4].

One of the goals of the present document is to ensure that it is straight forward to translate between a TOSCA Service Template which adheres to ETSI GS NFV-SOL 001 [i.4] and a JSON text document which adheres to the YANG models specified in the present document.

YANG [3] is a data modelling language used to model configuration data, state data, RPCs, and notifications for network management protocols. It is used by protocols such as NETCONF [i.1] and RESTCONF [i.2] to communicate such configuration, state, RPC or notification data. NFV descriptors described in ETSI GS NFV-IFA 011 [1] and ETSI GS NFV-IFA 014 [2], are therefore defined in the present document in the form of a YANG model.

The model follows the information model in ETSI GS NFV-IFA 011 [1] and ETSI GS NFV-IFA 014 [2] in its design.

5.2 Augmentation rules in YANG

IETF RFC 7950 [3], section 7.17 defines the "augment" statement that allows a module or a submodule to add nodes to the schema tree defined in an external module, or in the current module and its submodules, and to add to the nodes from a grouping in a "uses" statement.

An example of such use of the "augment" statement has been demonstrated in clause A.3, where in VnfInfoModifiableAttributes, two nodes that have been added to extend the node "extension" defined in the module.

Such an approach can be applied to configurable properties related to VnfConfigurableProperties, and as an example, add additional configurable properties.

6 NFV YANG module definitions

6.1 Introduction

The Network Function Virtualization (NFV) YANG module consists of VNFD, PNFD and NSD, among other things, as illustrated by the following hierarchical tree diagram of the etsi-nfv-descriptors YANG module. For annotations used in the tree diagram, please refer to IETF RFC 8340 [i.3].

module: etsi-nfv-descriptors

```
  +--rw nfv
     +--rw vnfd* [id]
     +--rw nsd* [id]
     +--rw pnfd* [id]
```

A complete tree diagram can be seen in the attached file etsi-nfv-tree.txt (text version) and etsi-nfv-tree.html (HTML version). The module files are also available at the following URL:

https://forge.etsi.org/rep/nfv/SOL006/blob/v2.6.1/src/yang/.

6.2 VNFD YANG Module definitions

This clause defines the YANG module that is used to model a single VNFD. The YANG model for the VNFD shall comply with the YANG specification available in etsi-nfv-vnfd.yang file attached to the present document. This file is also available at the following URL:

https://forge.etsi.org/rep/nfv/SOL006/blob/v2.6.1/src/yang/etsi-nfv-vnfd.yang.

6.3 NSD YANG module definitions

This clause defines the YANG module that is used to model a single NSD. The YANG model for the NSD shall comply with the YANG specification available in etsi-nfv-nsd.yang file attached to the present document. This file is also available at the following URL:

https://forge.etsi.org/rep/nfv/SOL006/blob/v2.6.1/src/yang/etsi-nfv-nsd.yang.

6.4 PNFD YANG module definitions

This clause defines the YANG module that is used to model a single PNFD. The YANG model for the PNFD shall comply with the YANG specification available in etsi-nfv-pnfd.yang file attached to the present document. This file is also available at the following URL:

https://forge.etsi.org/rep/nfv/SOL006/blob/v2.6.1/src/yang/etsi-nfv-pnfd.yang.

6.5 Descriptors YANG module definitions

This clause defines the YANG module that is used to model the descriptors in NFV. These include VNFD, PNFD, NSD and nested NSD. The YANG model for the descriptors shall comply with the YANG specification available in etsi-nfv-descriptors.yang file attached to the present document. This file is also available at the following URL:

https://forge.etsi.org/rep/nfv/SOL006/blob/v2.6.1/src/yang/etsi-nfv-descriptors.yang.

Annex A (informative): YANG modelling example for NFV

A.1 Introduction

This annex provides examples illustrating the application of the YANG model specified in the present document.

A.2 Multi-DF example

A.2.1 General

This example uses an NS with three constituents NFs:

- A Cloud Service Router (CSR) VNF.
- An Adaptive Security Appliance (ASA) VNF.
- A Deep Packet Inspection (DPI) PNF.

The nsd contains the following information:

- References to the two corresponding VNFDs "ASA" and "CSR" as well as the PNFD "physical-dpi" representing the PNF.
- Two virtual link descriptors providing requirements for the communication between the CSR and the ASA VNFs and between the ASA VNF and the DPI PNF: r2fw and fw2dpi (respectively).
- Two deployment flavour descriptions.

Both VNFs consist of a single VNFC. Hence the corresponding VNFDs contain a single VDU. Both of them have a single VNF DF with two instantiation levels "single" and "double".

The VNFD of the "CSR" VNF contains a single Virtual Deployment Unit (vdu) called "router" which consists of a Virtual Compute Descriptor called "csr-vcd" running a Software Image called "csr-image", and a Virtual Storage Descriptor (vsd) called "csr-vsd". The Software Image is a qcow2 image and runs on a "bare" Container Format.

Similarly, the VNFD for the "ASA" VNF contains a single vdu called "firewall" which consists of a vcd called "asa-vcd" running a Software Image called "asa-image", and a vsd called "asr-vsd". The Software Image is also a qcow2 image and runs on "bare" Container Format.

The "csr-vcd" and the "asa-vcd" is a vcd of 4G of memory and 2 virtual CPUs.

The following clauses focus on the two deployment flavors supported for this NS.

The entire configuration of these two deployment scenarios is defined in the attached nfv-example.xml and nfv-examle.json file attached to the present document.

A.2.2 Firewall Router Deployment Flavour Example

In this example outside traffic hits a CSR VNF instance from where the traffic flows to an ASA VNF instance, as illustrated in Figure A.2-1.

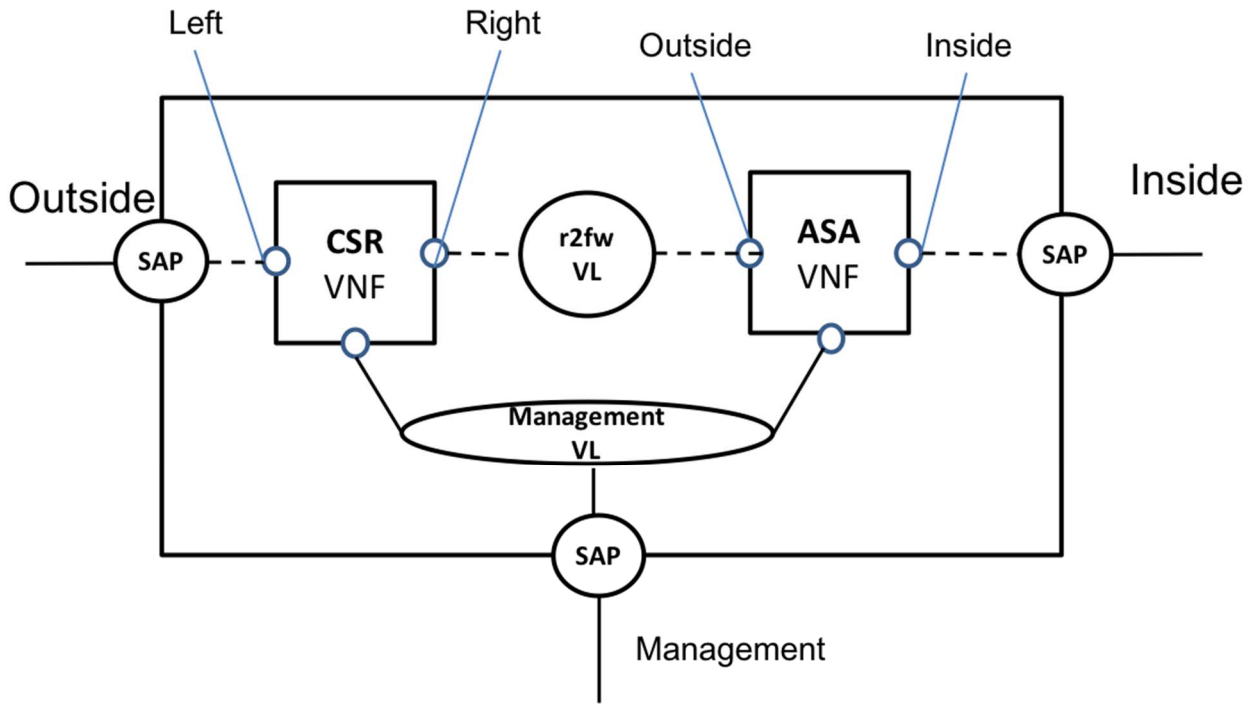

Figure A.2-1: Firewall Router Example

The traffic flow consists of external traffic that comes over the Service Access Point Descriptor (sapd) called "Outside" and realized as VNF external Connection Point called "Left". From there the traffic gets routed by CSR and exits the box and connects to the Virtual Link Profile "r2fw" using the Connection Point "Right". From the Virtual Link Profile "r2fw", traffic heads over the Connection Point "Outside" to the ASA firewall. The traffic exits the firewall using the Connection Point "Inside" and exits the Service Access Point Descriptor "Inside" into the enterprise.

A.2.3 Router Firewall DPI NS Deployment Flavour Example

In this example, the first two elements are the same as the previous example. The third element in this Deployment Flavour is a Deep Packet Inspection (DPI) engine defined using a PNFD, as illustrated on Figure A.2-2. The deployment flavour is named "fw-router-dpi" and contains a PNF profile in addition to the two VNF profiles used in the previous example.

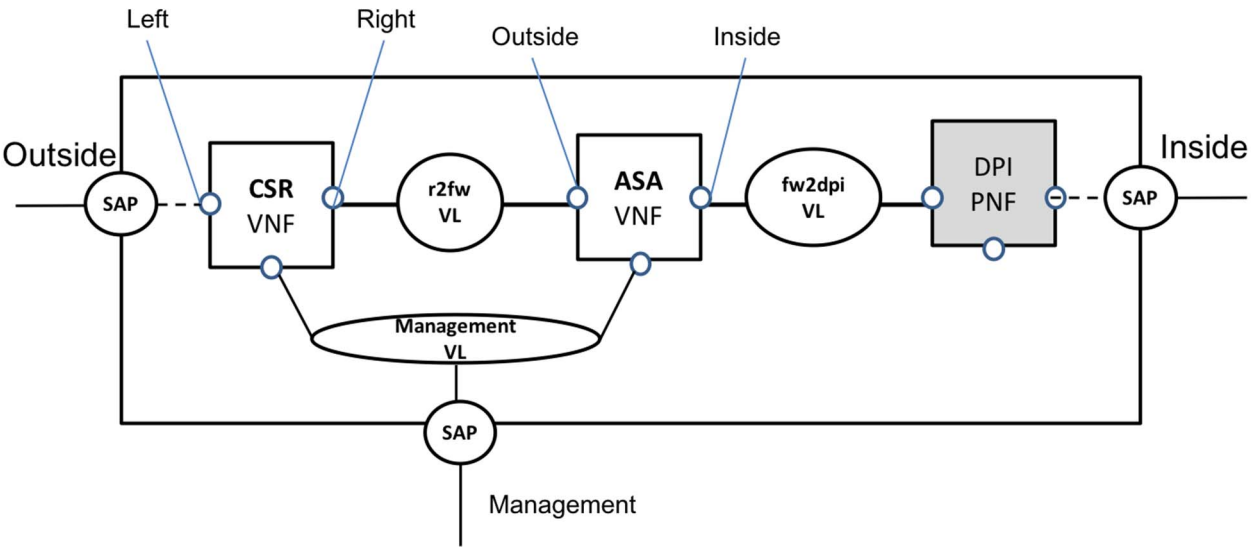

Figure A.2-2: Router Firewall DPI example

A.3 Extending VnfInfoModifiableAttributes

The method for extending VnfInfoModifiableAttributes consists in creating a YANG module that augments the nfv:nfv-descriptors/nfv:vnfd/nfv:modifiable-attributes/nfv:extension and/or nfv:nfv-descriptors/nfv:vnfd/nfv:modifiable-attributes/nfv:metadata definitions, depending on the type of modifiable attribute(s) to be added.

The following YANG module is an example for how VnfInfoModifiableAttributes can be extended to define two new attributes. This example tries to match a similar example in ETSI GS NFV-SOL 001 [i.4], clause 6.8.1.9.

In this example, the base model of etsi-nfv-descriptors is extended to add two new attributes 'http-proxy' and 'https-proxy' in the XPath /etsi-nfv-descriptors/vnfd/modifiable-attributes/extension. One difference between the example in ETSI GS NFV-SOL 001 [i.4] and this is the 'type' field. In this example, the example below defines the field as 'type uri' instead of 'type string', which can be a stricter check on the format of the string that is accepted. Such an extension can be provided by any vendor that wants to extend and support the two new parameters.

EXAMPLE:

```
module example-modifiable-attributes {
  yang-version 1.1;
  namespace "http://example.com/yang/example-modifiable-attributes";
  prefix ex-ma;

  import etsi-nfv-descriptors {
    prefix nfv;
  }

  import ietf-yang-types {
    prefix yt;
  }

  organization
    "European Telecommunications Standards Institute (ETSI)";

  description
    "Example for how VnfInfoModifiableAttributes can be augmented.";

  revision 2019-03-18 {
    description
      "Initial revision.";
  }

  augment "/nfv:nfv-descriptors/nfv:vnfd/nfv:modifiable-attributes/nfv:extension" {
    leaf http-proxy {
      type yt:uri;
      mandatory true;
      description
     "HTTP proxy defined as URI.";
    }

    leaf https-proxy {
      type yt:uri;
      description
     "HTTPS proxy defined as URI.";
    }
  }
```

END EXAMPLE

A.4 Extending VnfLcmOperationsConfiguration

The following YANG module is an example for how VnfLcmOperationsConfiguration can be extended to define two new attributes. This example tries to match a similar example in ETSI GS NFV-SOL 001 [i.4], clause 6.2.43.4. While this example shows how the particular operation instantiateVnfOpConfig is extended, all other LCM operations can follow this example.

In this example, the base model of etsi-nfv-descriptors is extended to add two new attributes 'parameter-1' and 'parameter-2" in the XPath /etsi-nfv-descriptors/vnfd/lcm-operations-configuration/instantiate-vnf-op-config. One difference between ETSI GS NFV-SOL 001 [i.4] and the present document is in that while ETSI GS NFV-SOL 001 [i.4] has defined a "placeholder' for where extensions can happen, no such restriction exists in the present document. That is because YANG does not allow for such restriction to be specified in the model. In this example, the present document defines the attributes as 'parameter-1' and 'parameter-2', both of 'type string'. Such an extension can be provided by any vendor that wants to extend and support the two new parameters.

EXAMPLE:

```
module example-instantiate-vnf-op-config {
  yang-version 1.1;
  namespace "http://example.com/yang/example-instantiate-vnf-op-config";
  prefix ex-ivoc;

  import etsi-nfv-descriptors {
    prefix nfv;
  }
  organization
    "My Company, Inc.";
  description
    "Example for how VnfLcmOperationsConfiguration can be augmented.";
  revision 2019-04-18 {
    description
      "Initial revision.";
  }
  augment "/nfv:nfv/nfv:vnfd/nfv:lcm-operations-configuration/nfv:instantiate-vnf-op-config" {
    leaf parameter-1 {
      type string;
      mandatory true;
      description
       "Extending instantiateVnfOpConfig with parameter-1.";
    }
    leaf parameter-2 {
      type string;
      default "value-2";
      description
       "Extending instantiateVnfOpConfig with parameter-2.";
    }
  }
}
```

END EXAMPLE

Annex B (informative): Authors & contributors

The following people have contributed to the present document:

Rapporteur:
Mahesh, Jethanandani, VMware

Previous Rapporteur:
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Annex C (informative): Change History

Date	Version	Information about changes
09 2018	0.0.3	Added conventions to section 4. Added Introduction to sections 5 and 6.
10 2018	0.0.4	Updated reference to tree diagrams. Added examples in Annex A.
11 2018	0.1.0	Added informative reference to IETF RFC 8040 - NFVSOL(18)000558. Added reference to file names for each YANG module section - NFVSOL(18)000578r1. Updated YANG files according to NFVSOL(18)000566r2 and NFVSOL(18)000656. Updated Section numbers and reference to Gitlab. Deleted empty clauses, fixed ETSI styles, removed duplicated annex title.
4 2019	0.2.0	NFVSOL(19)000195r1: Added informative example for VnfcInfoModifiableAttributes. NFVSOL(19)000199: Updated reference to YANG from IETF RFC 6020 to IETF RFC 7950. All references to YANG are now in all capital letters. Updated module name from etsi-nfv to etsi-nfv-descriptors. NFVSOL(19)000218: Added a section in clause 5 that talks about augmentation rules in YANG Updated module filenames, incorporated editor's note for the location of the file into the GS. NFVSOL(19)000232r1: Added an example on VnfLcmOperationsConfiguation can be extended. NFVSOL(19)236r2: Updates to GS for the addition of new modules. NFVSOL(19)000243: Final clean-up.

History

Document history		
V2.6.1	June 2019	Publication