

NFVRG
Internet-Draft
Intended status: Informational
Expires: December 23, 2016

P. Aranda Gutierrez
DRL. Lopez
Telefonica
June 21, 2016

High-level VNF Descriptors using NEMO
draft-aranda-nfvrg-recursive-vnf-00

Abstract

Current efforts in the scope of Network Function Virtualisation(NFV) propose YAML-based descriptors for Virtual Network Functions (VNFs). These descriptors are human-readable but hardly understandable by humans. On the other hand, there has been an effort proposed to the IETF to define a human-readable (and understandable) representation for networks, known as NEMO. In this draft, we propose a simple extension to NEMO to accomodate VNFDs in a similar manner as inline assembly is integrated in higher-level programming languages.

This approach enables the creation of recursive VNF forwarding graphs in Service Descriptors, practically making them recursive.

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 December 23, 2016.

Copyright Notice

Copyright (c) 2016 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](#) and the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>) in effect on the date of

publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Table of Contents

1.	Introduction	2
2.	Terminology and abbreviations	3
3.	Prior art	3
3.1.	Virtual network function descriptors	3
3.2.	NEMO	4
4.	Additional requirements on NEMO	5
4.1.	Referencing VNFDs in a NodeModel	5
4.2.	Referencing the network interfaces of a VNF in a NodeModel	5
4.3.	An example	6
5.	Conclusion	7
6.	IANA Considerations	7
7.	Security Considerations	7
8.	Acknowledgement	7
9.	References	8
9.1.	Normative References	8
9.2.	Informative References	8
9.3.	URIs	8
	Authors' Addresses	8

[1.](#) Introduction

Currently, there is a lot of activity going on to use NFV in the network. From the point of view of the orchestration, Virtual Network Functions are blocks that are deployed in the infrastructure as independent units. They provide for one layer of components (VNF components(VNFCs)) below, i.e. a set of VNFCs accessible to a VNF provider can be composed into VNFs. However, there is no simple way to use existing VNFs as components in VNFs with a higher degree of complexity. In addition, VNFDs used in different open source MANO frameworks are YAML-based files, which despite being human readable, are not easy to understand.

On the other hand, there has been recently an attempt to work on a modelling language for networks (NEMO). This language is human-readable and provides a NodeModel construct to describe nodes that supports recursiveness. In this draft, we propose an addition to NEMO to make it interact with VNFDs supported by a NFV MANO framework. This integration creates a new language for VNFDs that is

recursive, allowing VNFs to be created based on the definitions of existing VNFs.

This draft uses OpenMANO and OSM descriptor references as an example for the lowest level descriptors that are imported into NEMO. Conceptually, other descriptor formats like TOSCA can also be used at this level.

2. Terminology and abbreviations

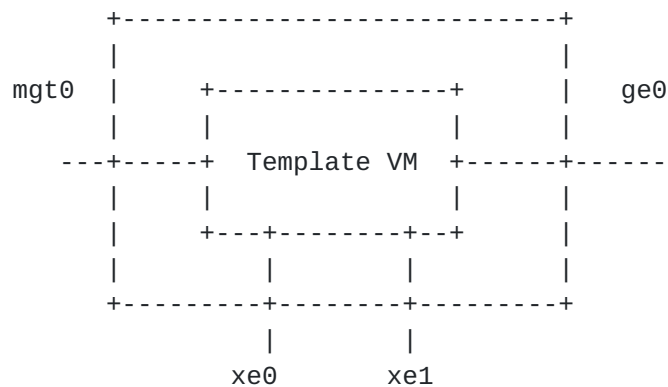
The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [[RFC2119](#)].

3. Prior art

3.1. Virtual network function descriptors

Virtual network function descriptors (VNFDs) are used in the Management and orchestration (MANO) framework of the ETSI NFV to achieve the optimal deployment of virtual network functions (VNFs). The Virtual Infrastructure Manager (VIM) uses this information to place the functions optimally. VNFDs include information of the components of a specific VNF and their interconnection to implement the VNF, in the form of a forwarding graph. In addition to the forwarding graph, the vnfd includes information regarding the interfaces of the VNF. These are then used to connect the VNF to either physical or logical interfaces once it is deployed.

There are different MANO frameworks available. For this draft, we will concentrate on the example of OpenMANO [[1](#)], which usesYAML [[2](#)]. Taking the example from the (public) OpenMANO github repository, we can easily identify the virtual interfaces of the sample VNFs in their descriptors:



vnf:

```

name: TEMPLATE
description: This is a template to help in the creation of
# class: parent          # Optional. Used to organize VNFs
external-connections:
-   name:                mgmt0
    type:                mgmt
    VNFC:                TEMPLATE-VM
    local_iface_name:    mgmt0
    description:         Management interface
-   name:                xe0
    type:                data
    VNFC:                TEMPLATE-VM
    local_iface_name:    xe0
    description:         Data interface 1
-   name:                xe1
    type:                data
    VNFC:                TEMPLATE-VM
    local_iface_name:    xe1
    description:         Data interface 2
-   name:                ge0
    type:                bridge
    VNFC:                TEMPLATE-VM
    local_iface_name:    ge0
    description:         Bridge interface

```

Figure 1: Sample VNF and descriptor (source: OpenMANO github)

3.2. NEMO

The Network Modeling (NEMO) language is described in [\[I-D.xia-sdnrg-nemo-language\]](#). It provides a simple way of describing network scenarios. The language is based on a two-stage process. In the first stage, models for nodes, links and other entities are defined. In the second stage, the defined models are instantiated. The NEMO language also allows for behavioural

descriptions. A variant of the NEMO language is used in the OpenDaylight NEMO northbound API [3].

NEMO allows to define NodeModels, which are then instantiated in the infrastructure. NodeModels are recursive and can be build with basic node types or with previously defined NodeModels. An example for a script defining a NodeModel is shown below:

```
CREATE NodeModel dmz
  Property string: location-fw, string: location-n2,
    string: ipprefix, string: gatewayip, string: srcip,
    string: subnodes-n2;
  Node fw1
    Type fw
    Property location: location-fw,
      operating-mode: layer3;
  ...
```

Figure 2: Creating a NodeModel in NEMO

4. Additional requirements on NEMO

In order to integrate VNFDs into NEMO, we need to take into account two specifics of VNFDs, which cannot be expressed in the current language model. Firstly, we need a way to reference the file which holds the VNFD provided by the VNF developer. This will normally be a universal resource identifier (URI). Additionally, we need to make the NEMO model aware of the virtual network interfaces.

4.1. Referencing VNFDs in a NodeModel

As explained in the introduction, in order integrate VNFDs into the NEMO language in the easiest way we need to reference the VNFD as a Universal Resource Identifier (URI) as defined in [RFC 3986](#) [[RFC3986](#)]. To this avail, we define a new element in the NodeModel to import the VNFD:

```
CREATE NodeModel NAME <node_model_name>
  IMPORT VNFD FROM <vnfd_uri>
```

4.2. Referencing the network interfaces of a VNF in a NodeModel

As shown in Figure 1, VNFDs include an exhaustive list of interfaces, including the interfaces to the management network. However, since these interfaces may not be significant for specific network scenarios and since interface names in the VNFD may not be adequate

in NEMO, we propose to define a new element in the node model, namely the ConnectionPoint.

```
CREATE NodeModel NAME <node_model_name>
  DEFINE ConnectionPoint <cp_name> FROM VNFD:<iface_from_vnfd>
```

4.3. An example

Once these two elements are included in the NEMO language, it is possible to recursively define NodeModel elements that use VNFDs in the lowest level of recursion. Firstly, we create NodeModels from VNFDs:

```
CREATE NodeModel NAME SampleVNF
  IMPORT VNFD from https://github.com/nfvlabs/openmano.git/openmano/vnfs/examples/dataplaneVNF1.yaml
  DEFINE ConnectionPoint data_inside as VNFD:ge0
  DEFINE ConnectionPoint data_outside as VNFD:ge1

  Import from a sample VNFD from the OpenMANO repository
```

Then we can reuse these NodeModels recursively to create complex NodeModels:

```
CREATE NodeModel NAME ComplexNode
  Node InputVNF TYPE SampleVNF
  Node OutputVNF TYPE ShaperVNF
  DEFINE ConnectionPoint input
  DEFINE ConnectionPoint output
  CONNECTION input_connection FROM input TO InputVNF:data_inside
    TYPE p2p
  CONNECTION output_connection FROM output TO ShaperVNF:wan
    TYPE p2p
  CONNECTION internal FROM InputVNF:data_outside TO ShaperVNF:lan
    TYPE p2p
```

Create a composed NodeModel

This NodeModel definition creates a composed model linking the SampleVNF created from the VNFD with a hypothetical ShaperVNF defined elsewhere. This definition can be represented graphically as follows:

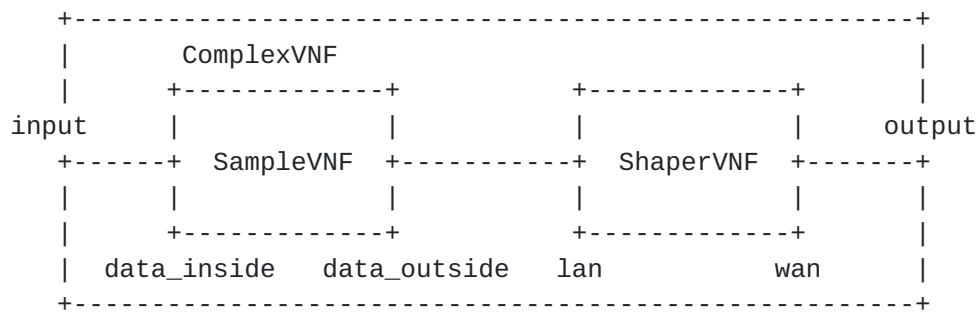


Figure 3

In ETSI NFV, a network service is described by one or more VNFs that are connected through one or more network VNFFGs. This is no more than what is defined in the composed NodeModel shown in Figure 3. By using NEMO, we provide a simple way to define VNF forwarding graphs(VNF-FGs) in network service descriptors in a recursive way.

5. Conclusion

With the strategy defined in this document, we are able to link a low-level VNF description into a high-level description language for networks like NEMO. Effectively, we are introducing recursiveness in VNFDs, allowing complex service descriptors to be built by reusing previously tested descriptors graphs as building blocks.

Although we have used the OpenMANO descriptor format in this document, other descriptors and concepts (i.e. as those used by TOSCA [4]) can also be used as the lowest level in this extension to the NEMO language.

6. IANA Considerations

This draft includes no request to IANA.

7. Security Considerations

The `IMPORT` construct allows referencing external resources. Developers using it in NEMO scripts are advised to verify the source of those external resources, and whenever possible, rely on sources with a verifiable identity through cryptographic methods.

8. Acknowledgement

This work has been partially performed in the scope of the SUPERFLUIDITY project, which has received funding from the European

Union's Horizon 2020 research and innovation programme under grant agreement No.671566 (Research and Innovation Action).

9. References

9.1. Normative References

- [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>>.
- [RFC3986] Berners-Lee, T., Fielding, R., and L. Masinter, "Uniform Resource Identifier (URI): Generic Syntax", STD 66, [RFC 3986](#), DOI 10.17487/RFC3986, January 2005, <<http://www.rfc-editor.org/info/rfc3986>>.

9.2. Informative References

- [I-D.xia-sdnrg-nemo-language]
Xia, Y., Jiang, S., Zhou, T., Hares, S., and Y. Zhang,
"NEMO (NETwork MODELing) Language", [draft-xia-sdnrg-nemo-language-04](#) (work in progress), April 2016.

9.3. URIs

- [1] <https://github.com/nfvlibs/openmano>
- [2] yaml.org
- [3] <https://wiki.opendaylight.org/view/NEMO:Main>
- [4] <http://docs.oasis-open.org/tosca/tosca-nfv/v1.0/tosca-nfv-v1.0.html>

Authors' Addresses

Pedro A. Aranda Gutierrez
Telefonica I+D
Zurbaran, 10
Madrid 28010
Spain

Email: pedroa.aranda@telefonica.com

Diego R. Lopez
Telefonica I+D
Zurbaran, 12
Madrid 28010
Spain

Email: diego.r.lopez@telefonica.com