A Fully Integrated Multi-Platform NFV SDK

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***Abstract*—A key challenge of network function virtualization (NFV) is the complexity of developing and deploying new network services. Currently, development requires many manual steps that are time-consuming and error-prone (e.g., for creating service descriptors). Furthermore, existing management and orchestration (MANO) platforms only offer limited support of standardized descriptor models or package formats, limiting the re-usability of network services.**

To this end, we introduce a fully integrated, open-source NFV service development kit (SDK) with multi-MANO platform support. Our SDK simplifies many NFV service development steps by offering initial generation of descriptors, advanced project management, as well as fully automated packaging and submission for on-boarding. To achieve multi-platform support, we present a package format that extends ETSI's VNF package format. In this demonstration, we present the end-to-end workflow to develop an NFV service that is then packaged for multiple platforms, i.e., 5GTANGO and OSM.

I. Introduction

In network function virtualization (NFV), developing and deploying a new network service requires developers to perform a number of manual steps. First, developers have to decide which virtual network functions (VNFs) to use in their service, selecting existing VNFs to reuse or implementing new ones. To specify how these VNFs are interconnected to a complex service, developers have to define the service structure and involved VNFs in a network service descriptor (NSD). Moreover, they need to create VNF descriptors (VNFDs) for each VNF, specifying details such as connection points, deployment units, and their virtual machine or container images.

Having created all necessary descriptors, developers need to combine and package them with other files like configuration scripts or disk images. Finally, the service package needs to be on-boarded to a management and orchestration (MANO) platform, which is then responsible to instantiate the service on the available NFV infrastructure (NFVI).

NFV promises short development cycles and fast time-to-market. However, many of the development steps are complicated and error prone (e.g., creating NSDs and VNFDs). Furthermore, the available MANO platforms are not fully compatible and each require descriptors and packages in slightly different flavors. Hence, developers either need to limit themselves to support only one of these platforms or have to take on the additional effort of manually creating separate descriptors and packages for each target platform.

To this end, we introduce a multi-platform NFV service development kit (SDK) that provides a set of seamlessly integrated tools, simplifying the development of NFV services. Our tools automate many of the development steps by generating initial descriptors through a graphical web interface, supporting the organization and management of files belonging to a service, as well as creating, validating, and on-boarding ETSI-compatible VNF and service packages. The proposed SDK is part of the 5GTANGO project [1], but unlike previous NFV SDKs [2], it is not specifically tailored to only support a single platform. Instead, our multi-platform SDK provides a common development environment, tooling, and workflow for different MANO platforms (e.g., 5GTANGO [1] and Open Source MANO (OSM) [3]). We use our novel, generic package format, which is ETSI-compatible and follows a layering concept to support the packaging of different artifacts for multiple target platforms and even non-VNF artifacts [4].

In this demonstration, we use an example network service to show how the proposed SDK can generate descriptors and create packages that can not only be on-boarded to the 5GTANGO service platform but also to other MANO platforms such as OSM. After on-boarding to the desired MANO platform, we illustrate the deployment of the created service on an emulated multi-PoP infrastructure using *vim-emu* [5].

II. Integrated multi-platform SDK workflow

Fig. 1 illustrates the end-to-end workflow of our demo, starting with the generation of service descriptors (1). For this, the *tng-descriptorgen* tool offers a web-based GUI that allows developers to specify high-level information about their network service and the involved VNFs (e.g., their order and disk images). The tool then generates the corresponding NSD and VNFDs based on the provided high-level information and sensible defaults (e.g., VNF connection points). In doing so, it automatically generates separate descriptors suitable for different MANO platforms. In the GUI, developers can edit generated descriptors, maintaining full flexibility with manual adjustments. Our tool automatically creates a project structure with a *project manifest* that references all generated descriptors and contains all information about the NFV service project.

The project can be further modified with the *tng-project* command-line interface (CLI) (2), e.g., to add or remove artifacts. These clearly defined NFV service projects can be treated like typical software development projects, e.g., using versioning or continuous integration tools.

As a next step, the project is packaged using the *tng-package* tool (3) which packages and signs the artifacts of the project using our novel 5GTANGO package format [4]. This format

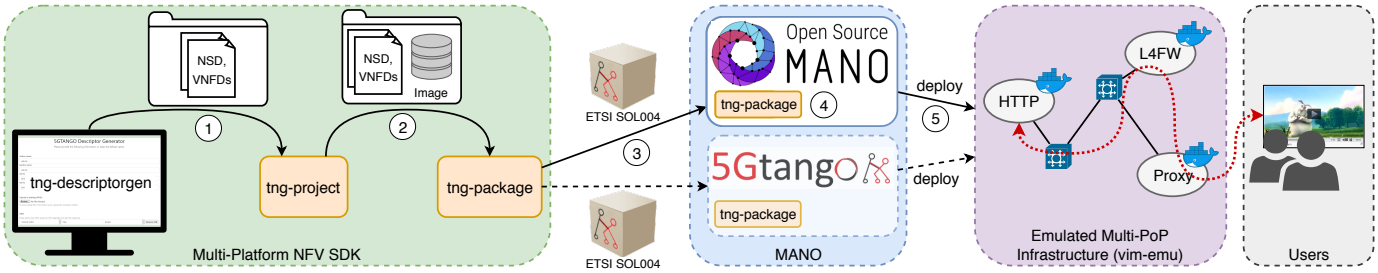

Fig. 1: End-to-end workflow of the multi-platform NFV SDK

extends the existing CSAR [6] and ETSI SOL004 [7] package standards and enables packaging of arbitrary artifacts. This allows using these packages to exchange individual VNFs, complete network services, or NFV test definitions. While remaining standard-compliant, packages can have multiple layers to separate artifacts for different MANO platforms. For example, the same package can contain a layer with an NSD and VNFDs for 5GTANGO and another with descriptors compatible to OSM. Hence, the same package can be used to on-board the developed service to either MANO platform, given that *tng-package* is added to this platform to unpackage the package and inject the unpackaged artifacts into the platform's catalogs (4). Since *tng-package* can be deployed as a micro service exposing a REST API, it can easily be integrated in existing MANO platforms. It comes with pluggable storage backends to store the unpackaged artifacts, for example, in the 5GTANGO catalogs or the OSM rel. FOUR platform catalogs.

The described process is transparent to the MANO platform as it simply receives the unpackaged network service in its required format. Hence, using the desired MANO platform, the service can then be deployed on the underlying NFVI (5).

III. Demonstration

The objective of the planned demonstration is to illustrate the end-to-end workflow with the proposed multi-platform NFV SDK. We show how a developer can use the GUI to generate descriptors for a network service consisting of multiple chained VNFs, organize all corresponding artifacts in a project, and package them. As a realistic example service, we use a CDN-like network service consisting of three chained VNFs: A caching proxy based on Squid[1], a layer-4 forwarder based on Socat[2], and an Apache[3] web service that acts a content provider. We then on-board the developed service, e.g., to OSM, and instantiate it. The instantiated service is then tested by streaming video through the involved VNFs. Specifically, the demonstration includes the following steps:

1) Generate descriptors with the *tng-descriptorgen* GUI
2) Organize the created project with the *tng-project* CLI
3) Package the complete project with the *tng-package* CLI
4) On-board the package and let it automatically be unpackaged using a *tng-package* instance integrated into the MANO system
5) Instantiate the service and interact with it, e.g., play video stream

The entire workflow can be executed on a regular laptop and the code of all involved software components as well as their install instructions are available on GitHub [8]. A video showing parts of the demo is available on YouTube[4].

IV. Conclusion

Our demonstrated multi-platform NFV SDK greatly simplifies and accelerates the development process of new network services and makes it less error-prone. It also removes the overhead of manually constructing separate descriptors and packages for different MANO platforms. Hence, developers using our SDK and its generic package format have more time to focus on building great network services.

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[1]Squid: http://www.squid-cache.org
[2]Socat: http://www.dest-unreach.org/socat/
[3]Apache HTTP: http://httpd.apache.org

[4]Demo YouTube video: https://youtu.be/sAdZLonRWgc