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NFV Service Dynamicity with a DevOps Approach:
Demonstrating Zero-Touch Deployment & Operations

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Abstract—Next generation network services will be realized
by NFV-based microservices to enable greater dynamics in
deployment and operations. Here, we present a demonstrator that
realizes this concept using the NFV platform built in the EU FP7
project UNIFY. Using the example of an Elastic Router service,
we show automated deployment and configuration of service
components as well as corresponding monitoring components
facilitating automated scaling of the entire service. We also
demonstrate automatic execution of troubleshooting and debug-
ging actions. Operations of the service are inspired by DevOps
principles, enabling quick detection of operational conditions and
fast corrective actions. This demo conveys essential insights on
how the life-cycle of an NFV-based network service may be
realized in future NFV platforms.

I. INTRODUCTION

New network services demand higher levels of automation
and optimized resource usage [1]. Our demo supports NFV
service dynamicity by offering fully automated scaling and
troubleshooting procedures. Flexible deployment and opera-
tions are enabled by the architecture of the UNIFY or-
chestration platform combined with an adaptive monitoring
framework and a flexible yet performant Infrastructure Node.

The demo scenario showcases a situation where the Data
Plane resources of a single router are not enough to handle
the increased traffic load that it is facing. We demonstrate the
autonomous scaling of the routing service and later introduce a
bug that the framework detects and debugs on its own. During
the demo, we highlight different events through deployment,
assurance, and troubleshooting phases, all supported by the
modular approach of our proof of concept implementation.

Implementation details and discussion on relevant lessons-
learned can be found in a related IM’17 experience paper [2],
while all technical background information regarding the
UNIFY NFV platform are available in [3] and [4].

II. THE DEMO SETUP

The demo setup (Fig. 1) was realized on three nodes running
on separate servers:

1) The Global Orchestrator Node keeps track of the
available infrastructure and accepts a high-level Service
Graph (SG) which describes the service as a monolithic

(router with four ports. A decomposed Network-Function-
Forwarding-Graph (NF-FG) is derived from this SG,
consisting of a set of service components to be deployed
(right side of Fig. 1). This translation results in a Control
Plane component—the Ctrl App on Fig. 1, implemented
by a Ryu OpenFlow controller—and a single Data Plane
component—the ovs, implemented by Open vSwitch.
The NF-FG links these two components, deployable as
Docker containers. It is then further mapped by the
Orchestrator to the available infrastructure.

2) The Universal Node (UN) is a common hardware
compute node that runs a local orchestrator software
as well as a monitoring controller (MMP). It supports
the deployment of different VNF types, specified in
the NF-FG it receives. It is also capable of starting
and configuring a set of monitoring components [5], as
specified in a special NF-FG annotation (MEASURE)
expressing monitoring intents for the service components.
To sustain communication between the different compo-
nents, a secure message bus (DoubleDecker) distributes
control and monitoring information including scaling or
troubleshooting triggers.

3) After deployment, the Troubleshooting Node which is
also connected to the message bus, listens for notifica-
tions from the monitoring framework in the Infrastruc-
ture Node. Once an anomaly in the deployed service
is detected, EPOXIDE, our specialized troubleshooting
framework, automatically executes a user-defined trou-
bleshooting process.
During the demo\textsuperscript{2}, the deployment and scaling of the Elastic Router can be followed on a web-GUI exposed by the Ctrl App and the UN. The monitored data is shown in real-time on a Grafana dashboard and the Troubleshooting Node offers live output and interactive input via an Emacs-based interface.

III. THE ELASTIC ROUTER LIFE-CYCLE EVENTS

Fig. 2 depicts parts of the gathered monitoring data during the demonstration run of the Elastic Router service. To detect undesired conditions, the framework uses two metrics: the CPU load (gathered by cAdvisor), and the overload risks of the Data Plane components. The latter is a statistical estimation by RAMON, giving the risk of the byte-rate reaching an upper limit (e.g., the line-rate) [5]. In the following, we walk through the main life-cycle events of the service. These events are highlighted during the demo, and are tagged in Fig. 2.

A—Deployment: The SG is passed to the Global Orchestrator which maps it to the UN’s available resources and sends it the initial NF-FG for further deployment. The UN starts the two service components—the Ctrl App and one ovs Docker container—and sets up the necessary network links as described in the NF-FG. Additionally, the information in the MEASURE annotation of the NF-FG triggers the startup and configuration of the monitoring components. These, in turn, start to gather metrics related to the resource usage of the deployed service—i.e. CPU load and bandwidth utilization.

B—Traffic Flow Start: After the service is fully deployed, a traffic generator is started and traffic is sent to the four ports of the elastic router. Initially, one Data Plane component (ovs) is enough to forward the traffic between the four ports.

C—Scale Out Start: The traffic generator gradually increases the packet rate on the four ports until a threshold for aggregated overload risk is reached. This is detected by the monitoring framework and a ‘scale out’ message is sent to the Ctrl App. This event triggers the Ctrl App to generate a new NF-FG, instructing the Orchestrator to deploy extra Data Plane components (ovs2–5 in Fig. 1) and handle the increased load. While scale-out is executed, monitoring is put on hold, as shown by the gap in the curves of Fig. 2 between C and D.

During this interval, the scale out procedure can be monitored on the web-GUI of the Ctrl App.

D—Scale Out End: The new, scaled NF-FG also includes a new MEASURE annotation. Thus, when scale-out is finished, the monitoring framework resumes gathering data on the freshly deployed Data Plane components, which start forwarding traffic between the ports as depicted on the data graph: four streams are now being generated, one for each ovs.

E—Troubleshooting: Shortly before time E we introduce a bug to a flow table in one of the ovs instances, causing the balanced traffic load to get disturbed. Monitoring components (marked with 1 in Fig. 1) detect this anomaly at time E through the high variance between loads on the Data Planes. This initiates an automatic troubleshooting process by sending a trigger to the Troubleshooting Node (see 2). To debug this decomposed service, the EPOXIDE troubleshooting framework relies on special-purpose debugging tools to locate the error. A Recursive Query Engine (3) is used to check the persistence of the error condition. It confirms the need for debugging, hence the AutoTPG (4) flow table verification tool is applied on each of the ovs instances. In order to properly setup and apply each tool, the troubleshooting framework automatically retrieves relevant information (e.g., IP and port numbers) from different components in the UNIFY architecture. Once the faulty entry in the misconfigured ovs instance is located, it is reported to the troubleshooting operator. 5 marks the only event when the operator has to interact with the troubleshooting framework to remedy the error condition.

F—Bug Fix: The operator manually corrects the bug, consequently the traffic loads on the different ovs components converge again.

To sum up, this demo showcases automated deployment of an NFV service with dynamic and autonomous service scaling combined with programmable, zero-touch monitoring and troubleshooting. Thus, the NFV platform successfully adopts the principles of a DevOps approach where real-time service observability and swift debugging are key features.

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REFERENCES


\textsuperscript{2}A screencast of the demo scenario is at: https://youtu.be/fSxyKBzKVes