The Sixteenth Advanced International Conference on Telecommunications
AICT 2020
September 27, 2020 to October 01, 2020 - Lisbon, Portugal

5G Programmable Infrastructure Orchestration using ONAP

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Acknowledgement: This work was partly funded by the European Commission under the European Union's Horizon 2020 program - grant agreement number 815074 (5G-EVE project) and 857201 (5G-VICTORI). The paper solely reflects the views of the authors. The Commission is not responsible for the contents of this paper or any use made thereof.

Agenda

1. Overview (slides 3-6)
2. ONAP service orchestration high level flow (slide 7)
3. ONAP 5G infrastructure orchestration test bed (slide 8)
4. High level slice deployment flow description (slide 9)
5. Next steps (slide 10)

Abstract

5G evolution is disruptive for the telco operators challenging them to embrace new concepts such as software centric networks and to change their operational model.

5G brings a very advanced radio layer and the network programmable concept accessible through API's, allowing verticals to seamlessly integrate their applications within the 5G ecosystem.

It require more advanced skills, more frequent network operations, it will be more prone to errors and incidents raising the need for automation and strict control mechanism enforcements.

This paper presents a programmable infrastructure facilitating the adoption of 5G leveraging ONAP capabilities for implementing slicing capabilities, work developed within two European projects 5G-EVE (https://www.5g-eve.eu/) and 5G-VICTORI (https://www.5g-victori-project.eu/).

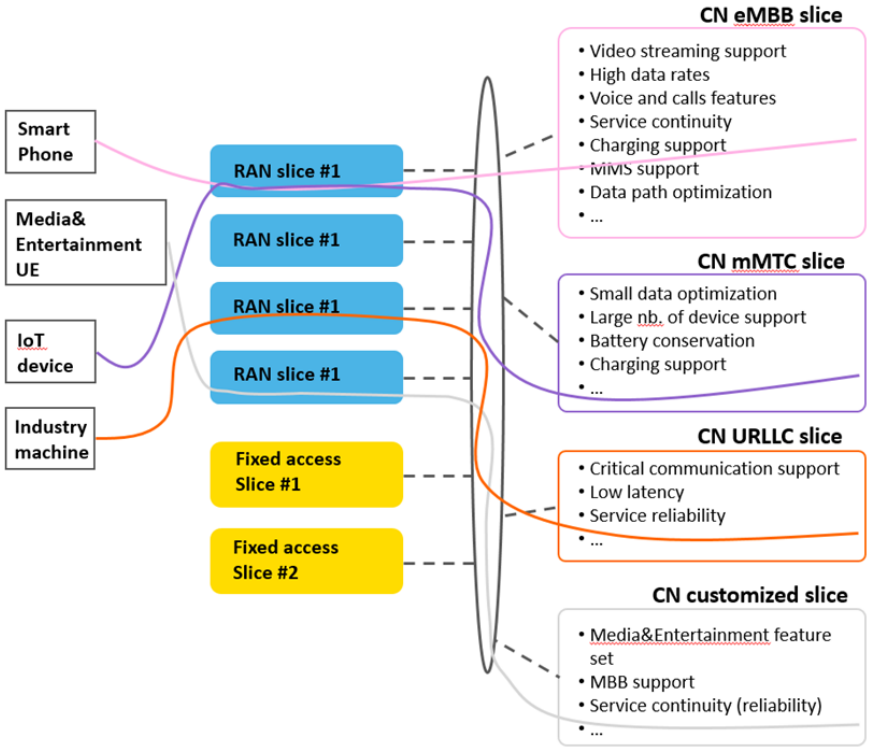
5G drives new automation challenges

Large number of edge sites
- more than 100 edge nodes

High diversity of applications
- virtual network functions
- analytics & AI/ML, IoT, microservices

Highly dynamic environment
- frequent apps reconfiguration
- network slicing, radio optimizations

Onboarding, deployment and in life management



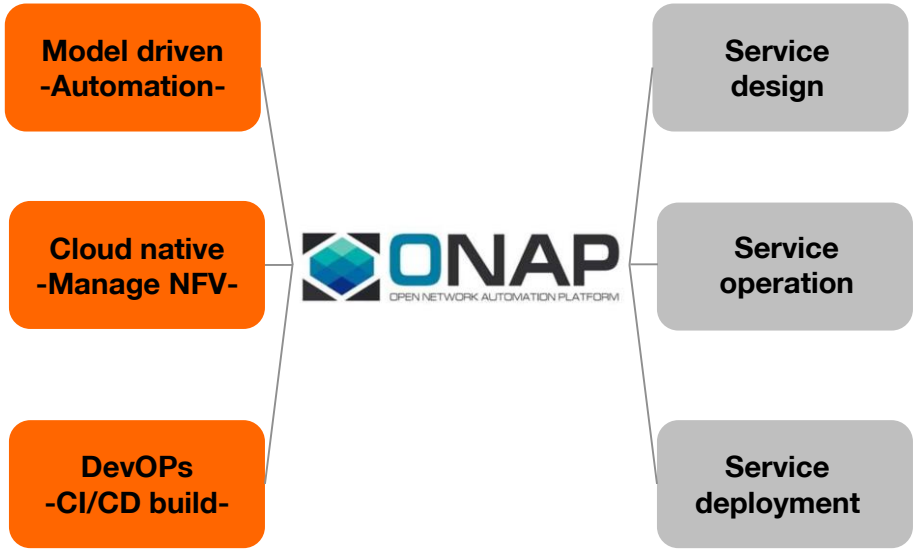
Orchestration layer is a mandatory part for design and creation of VNFs and network services end to end management.

Programmable infrastructure orchestration

The paper address a programmable infrastructure leveraging ONAP capabilities developed within two European projects: 5G-EVE and 5G-VICTORI.

The technical capabilities of the programmable infrastructure deployed within 5G-EVE and how it will further be utilized by the vertical use cases from 5G-VICTORI are being explored.

ONAP solution was selected for NFV/VNFs onboarding and service deployment in 5G Non Standalone Architecture (5G NSA).



Key innovations

Slicing implementation using the ONAP over the OpenStack cloud infrastructure.

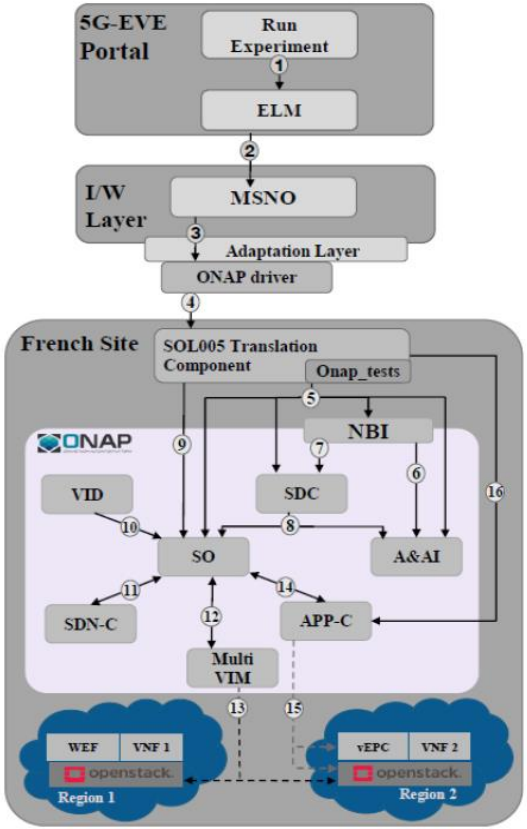
Virtual Network Functions (VNFs) onboarding, deployment and in life management together with the 5G slicing capabilities for Radio Access and Core networks.

1. **VNFs OpenStack environment deployment: (RAN) VNFs Kubernetes container based using Kubernetes , Core VNFs VM based.**
2. **Slicing mechanism and proper radio resource allocation supported in the RAN through (OAI)-FlexRAN SDN controller**
3. **OAI-Core for QoS assurance in the proposed communication network deployment.**

ONAP service orchestration high level flow

Objective - deployment of telco VNFs - virtual Evolved Packet Core (vEPC) and virtual Radio Access Network (vRAN) for supporting different 5G use cases to be developed in the 5G-VICTORI project.

1. services are represented as forwarding graphs composed of multiple VNFs in ONAP catalog
2. deployment process for each VNF begins with creation of the vendor's entitlements using Vendor Software Product (VSP)
3. onboard the VNF using HEAT template mapping ONAP specific requirements
4. each template is checked automatically during uploading
5. certification process start
6. ONAP deployment service instance on virtualized infrastructure



5G-EVE ONAP implementation

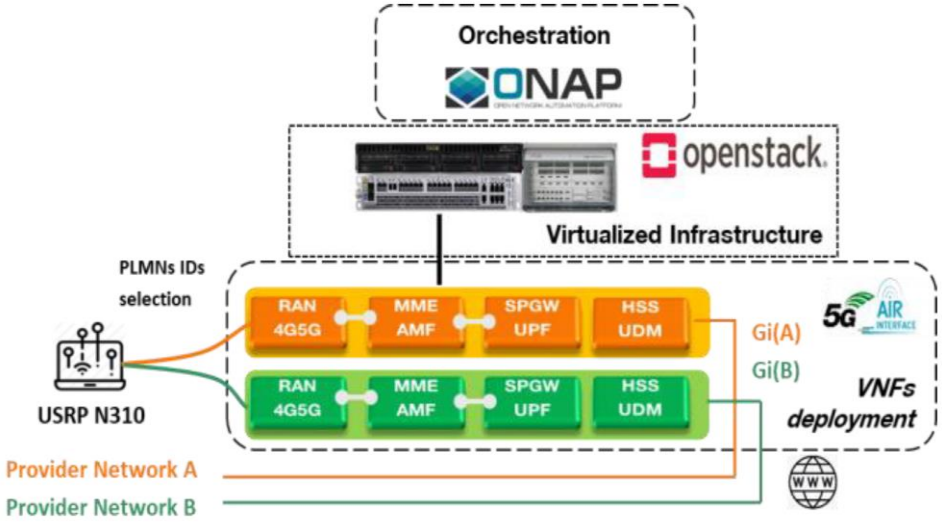
ONAP 5G infrastructure orchestration test bed

Test bed composition for two (A/B) end to end network slice instantiation:

- eNodeB PNF, 4G/5G video cameras
- radio licensed spectrum
- IP/MPLS between Bucharest and Alba Iulia Municipality infrastructure facility
- L3VPNs and IPsec connectivity between 5G-VICTORI infrastructure and 5G-EVE French
- control and compute servers, storage
- MEC for video data analytics
- ONAP cluster

The virtualized infrastructure will be deployed using OSMv5

- ONAP and SDNC suite and Prometheus used for performance monitoring
- NFV/VNF suite is provided through 4G5G RAN OAI Mosaic5G for radio part, 4G5G Core OAI Mosaic5G for core part and the application software for use case application experimentation
- Grafana is used for Service data visualization and KPI performance validation.



5G testbed for programmable infrastructure orchestration using ONAP

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Slice deployment flow – high level description

1. Two end to end network slices deployed using the described NFV/VNFs components.

2. Computing environment prerequisites configured in OpenStack infrastructure, to instantiate and run the VNF.

3. Connect each slice to its own OpenStack provider network, throughout ONAP.

4. Infrastructure configuration of the physical host where the VM is intended to be deployed through ONAP. The physical host must have available the following special CPU flags enabled.

5. Enable KVM mode to be used in the OpenStack for the compute_driver parameter.
VNF configure OpenStack specific flavor.

6. vRAN VM is running check
VM CPU allocation and configuration check
RAN VNF application automatically instantiation on the VM using start.mosaic5g script.

7. slice successful instantiation

```
[INFO] [X300] X300 initialization sequence...
[INFO] [X300] Maximum frame size: 1472 bytes.
[INFO] [X300] Radio 1x clock: 184.32 MHz
[INFO] [GPS] Found an internal GPSDO: LC_XO, Firmware Rev 0.929a
[INFO] [0/DmaFIFO_0] Initializing block control (NOC ID: 0xF1F0D00000000000)
[INFO] [0/DmaFIFO_0] BIST passed (Throughput: 1319 MB/s)
[INFO] [0/DmaFIFO_0] BIST passed (Throughput: 1316 MB/s)
[INFO] [0/Radio_0] Initializing block control (NOC ID: 0x12AD100000000001)
```

8. end to end slice functionality check based on the vMME statistics

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Next steps – work in progress

1. In-life slice automated configuration - performed by increasing the network compute capacity triggered by service reconfiguration request initiated by the user through the portal or as a result of control loop automation actions
2. In-life management capabilities - upgrade, network slice instance (NSI) scaling, changes of NSI capacity, changes of NSI topology
3. The entire functionality will be further evaluated on 5G-VICTORI France/Romania cross site orchestration cluster using 5G-EVE test bed facilities in two use cases: transportation and energy.

Thank you!