Wireless Slicing Services (WISE)

1.1. Scope of this document

This document is to describe the purpose of the demonstration and the architecture of the test infrastructure that was used by the NECOS consortium. This test infrastructure is not precluding that any other can be used to run de demonstration. The guide to install the software in the substrate resources is provided in the README file, in the same repository as the software.

1.2. Introduction

In this demonstration, multiple slice allocations are requested via one Slice Provider hosted by UFPA and the Resources Providers participating at the UFRN, as depicted in **Figure 1**.

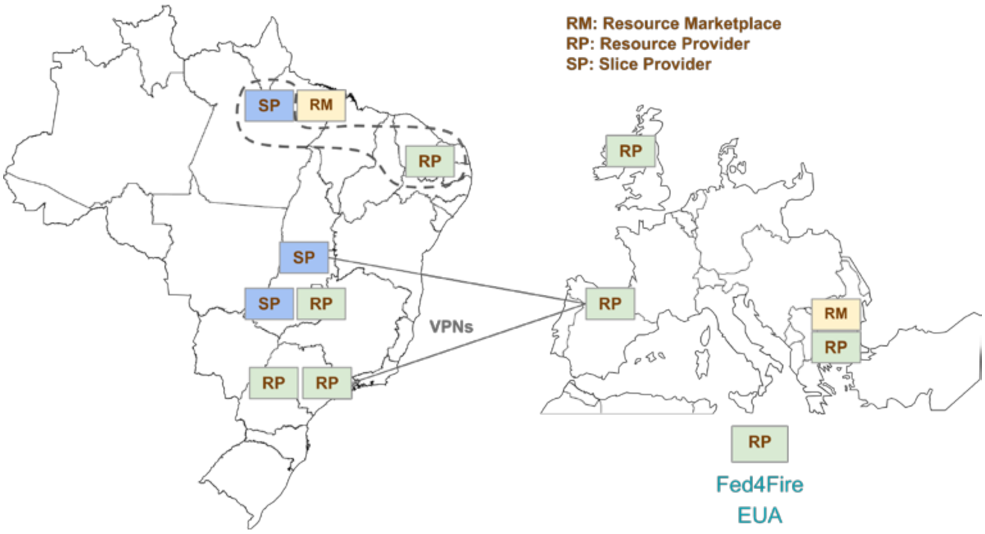

Figure 1. Instantiation of WISE on the experimental infrastructure.

1.3. License

All the source code developed within the NECOS project, and made available as OSS, is released under the Apache License – Version 2.0[1]

1.4. Objectives

The Wireless Slicing sErvices (WISE) demo shows the NECOS LSDC capabilities in expanding the cloud-network slinging concept towards wireless network domains. In

[1] http://www.apache.org/licenses/LICENSE-2.0

general terms, the WISE [Maxweel, 2019] solution outperforms the state-of-the-art in WiFi-shared access by deploying an end-to-end slice-defined approach, enabling WLAN networks tailored to serve the demands of specific scenarios and applications needs. Moreover, WISE allows carriers to be capable of both managing and controlling home-premised off-the-shelf WiFi routers at the runtime by harnessing a fully softwarized approach. The WISE solution addresses the gaps of existing WiFi sharing tools, such as the widely used FON[2] global WiFi network, which only allows traffic isolation and differentiated services at the CPE premises, as well as only permits system reconfigurations on-site (fully customer-centric).

Contrary to the FON WiFi sharing service fully deployed within WiFi router premises, WISE turns off-the-shelf WiFi routers into a simple CPE, focused on provisioning WiFi access to mobile devices through different virtual networks. The WISE WiFi sharing control services run out of the CPE, namely in virtual CPE applications running at edge node premises. Thus, all incoming traffic that belongs to different virtual WiFi networks must be subjected to respective virtual network functions before going forward. In light to achieve this, the legacy WISE solution relies on external technologies to provide all the necessary resources. The idea behind harnessing the NECOS hub of services (i.e., the NECOSization of the WISE approach), stands to rely upon the LSDC approach for orchestrating and managing all necessary resources so that the WISE solution can run as a service. Thus, NECOS foresees to provide WISE-enabled WiFi sharing systems with capabilities for end-to-end service-oriented networking services, including full isolation and auto-scaling, as well as customization and control at runtime. The goal of the WISE demo is to assess the LSDC approach performance in a lab-premised testbed deployed in the UFRN's REGINA-Lab premises, which hosts all NECOS components in the core DC. **Figure 2** depicts the testbed configuration of the WISE demo.

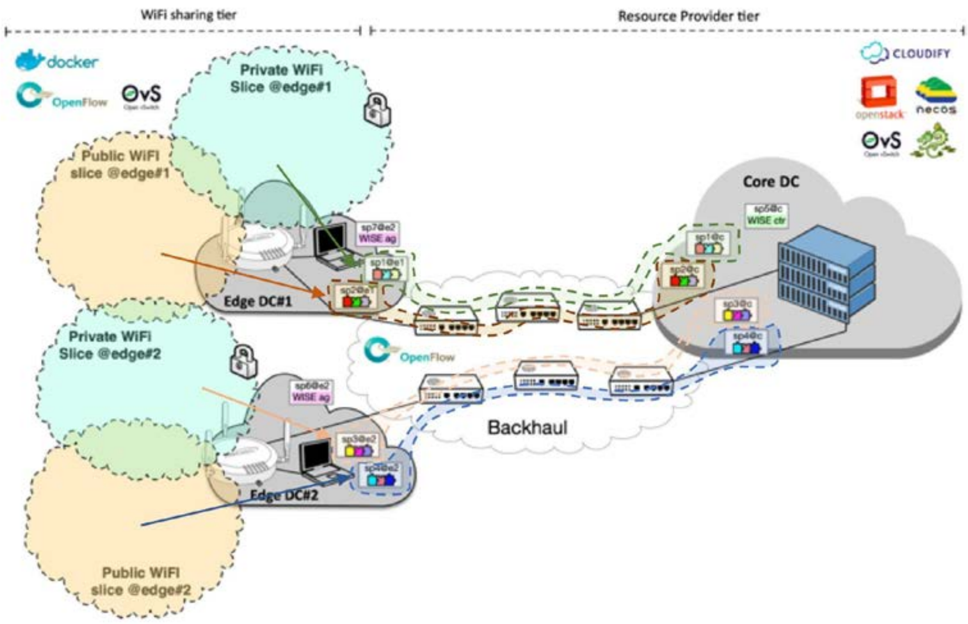

Figure 2. Testbed configuration of the WISE demo.

2 http://fon.com/

The WISE demo considers a scenario in which carriers exploit public WiFi coverage coming from residential hotspots to support 5G's ultra-dense networking. For instance, distinct carriers may want to purchase WISE-enabled WiFi sharing systems to complement their cellular networks with broadband wireless access featuring end-to-end isolation, customization and independent service provisioning. Such a WiFi-assisted network densification proceeds in two stages: i) by harnessing the NECOS LSDC approach to orchestrate the necessary cloud-network slice resources all the way from the core DC to the WiFi CPE. More specifically, the NECOS LSDC approach takes slicing template specifications for building (and decommissioning afterwards) a pair of containers at both edge DCs and the core DC in a per virtual WiFi granularity, each pair hosting same chaining WISE VNFs; one container in the edge DC to host the WISE Agent application; and, one container in the core DC to run the WISE Controller. In the end, the NECOS LSDC approach builds network slices connecting all the cloud slice parts and the WiFi virtual networks.

The WISE Controller relies on particular VIM and WIM that NECOS provides to the carrier in order to enable the dynamical control and management of all the computing, storage, and network resources within the entire cloud-network slicing topology; ii) by applying end-to-end cloud network slice definitions on top of the WISE-enabled Wi-Fi sharing technology, with the aim of offering multi tenancy and multi service support for a wide range of services.

On the basis of the Wi-Fi slicing concept, typical WiFi WLAN-sharing services implement virtualization to accommodate two virtual networks within the common Wi-Fi spectrum for shared connectivity. Similarly, NECOS maps the description of the desired service capabilities (provided as YAML file) into two end-to-end cloud-network slices: (i) a “public” one, devoted to community Internet access, and (ii) a “private” one, for particular devices attached to the Wi-Fi owner’s network. Each demanded cloud network slice comprises a set of dc and network slice parts as follows:

- A public and a private WiFi slice parts, consisting of virtual access points (vAPs) running on top of an OpenWRT-empowered off-the-shelf CPE;
- Eight (8) Edge dc slice parts consisting of different NFV service chaining instances running locally at mini dc equipment premises (a laptop), in the form of vCPE applications;
- Eight (8) WAN network slice parts consisting of the required virtual networking infrastructure (e.g., nodes, links, interfaces, etc.) for proper edge-to-core cloud slicing connectivity;
- Eight (8) core dc slice parts consisting of the required computing and storage resources to accommodate additional services such as a general-purpose software application.

Two off-the-shelf Wi-Fi router TP-LINK TL-WR1043ND v3 (CPU of 720 MHz, and RAM of 64 MB), running the OpenWRT v18.069 and the WAN Slice Controller implementation, is adopted to provision the Wi-Fi-sharing technology. A laptop DELL VOSTRO 5480 (Core I7-5500U, RAM 8GB, HDD 500GB) implements the edge DC, whilst a two clustering rack servers PowerEdge R7425 (2AMD 32-core EPYC processors, 64GB DIMM DDR4 RAM, 4 HDD 2TB, and 4 Gb Ethernet network cards) compose the core cloud. In short, the WAN Slice Controller creates vAPs that can run on a physical router to provide service-oriented WLANs for specific applications. An SDN infrastructure featuring 6 OpenFlow-enabled Mikrotik 951G-2HnD (CPU of 600 MHz, and RAM of 128 MB) meshed switch nodes provide wired connectivity between the edge and core DCs.

1.5. Workflow

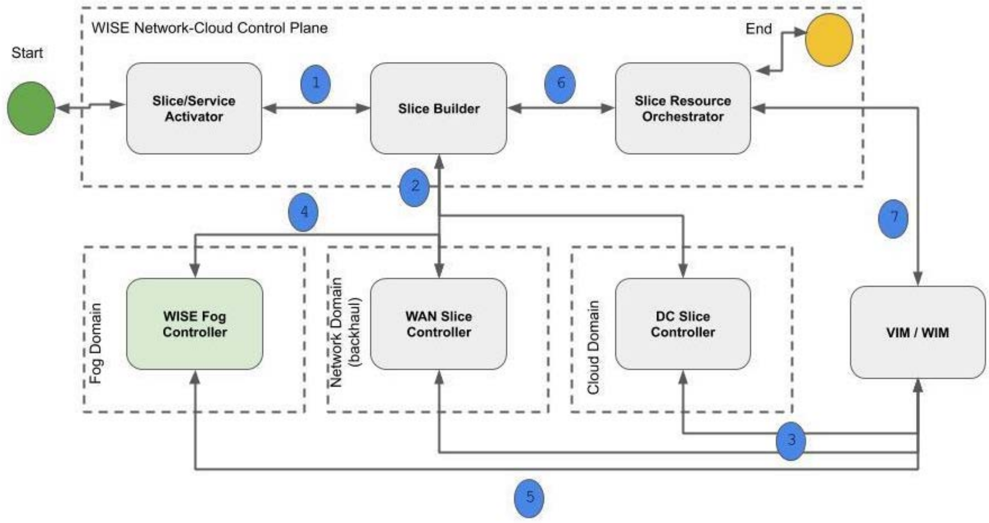

Figure 3. WISE workflow.

As shown in **Figure 3**, the demo has seven steps which are detailed below.

- **Step 1:** Slice Activator receive a YAML file with slice and service description (based on NECOS information model) and requests an end-to-end cloud-network slice deployment to slice builder;
- **Step 2:** Slice Builder interacts with already deployed DC/WAN controllers in order to create different slice parts (including WiFi, network and edge/core DC slice parts);
- **Step 3:** DC/WAN deploys VIM/WIM on demand in the edge DC, network and core DC domains;
- **Step 4:** WAN Controller communicates with WISE edge DC controller to deploy two new slices, one for the public and another for private purposes, upon the network domain;
- **Step 5:** WAN Controller associates the deployed WIM with the public and private slice parts;
- **Step 6:** Slice Builder informs SRO about Slice creation process;
- **Step 7:** SRO deploy slice services in each VIM/WIM based on slice description from Service Activator. After that, SRO can manage cloud, network and WiFi resources in the edge DC, wan and core DC.