5TONIC
5G Open Research and Innovation Laboratory

July 2018

5TONIC infrastructure

5TONIC is an **open co-creation laboratory** focusing in 5G technologies, founded by Telefónica and IMDEA Networks and based in Madrid. The 5TONIC infrastructure can be divided as follows:

→ Permanent lab infrastructure

Intended to support trials of use cases and available for all the members
It includes:

- **Data center infrastructure** including racks for each 5TONIC members, communications infrastructure
- **Virtual EPC** provided by Ericsson, to evolve to NGC
- **LTE Radio Access infrastructure**, provided by Ericsson and CommScope, to be evolved to NR
- Virtualization, processing and transport infrastructure

→ Temporal infrastructure

Deployed to support **specific demos** by members, associated with EU projects, as well as 5TONIC technological trials: Cohere Technologies, Luz Wavelabs, Saguna,…

It is partially provided by the members and collaborators involved on a temporal basis

- Demos supported associated with specific events (reviews, winter/summer schools,…) of several projects: 5G-Ex, 5G-CORAL, 5G-RANGE
- Demos associated to specific projects 5TONIC members are involved in: CrossHaul, 5G-TRANSFORMER
- Semipermanent infrastructure to support testbeds in specific projects: 5GINFIRE

Telefónica   iMdea networks   ERICSSON   uc3m   (intel)   COMMSCOPE   cohere technologies   aLTRan   INTERDIGITAL   redhat.

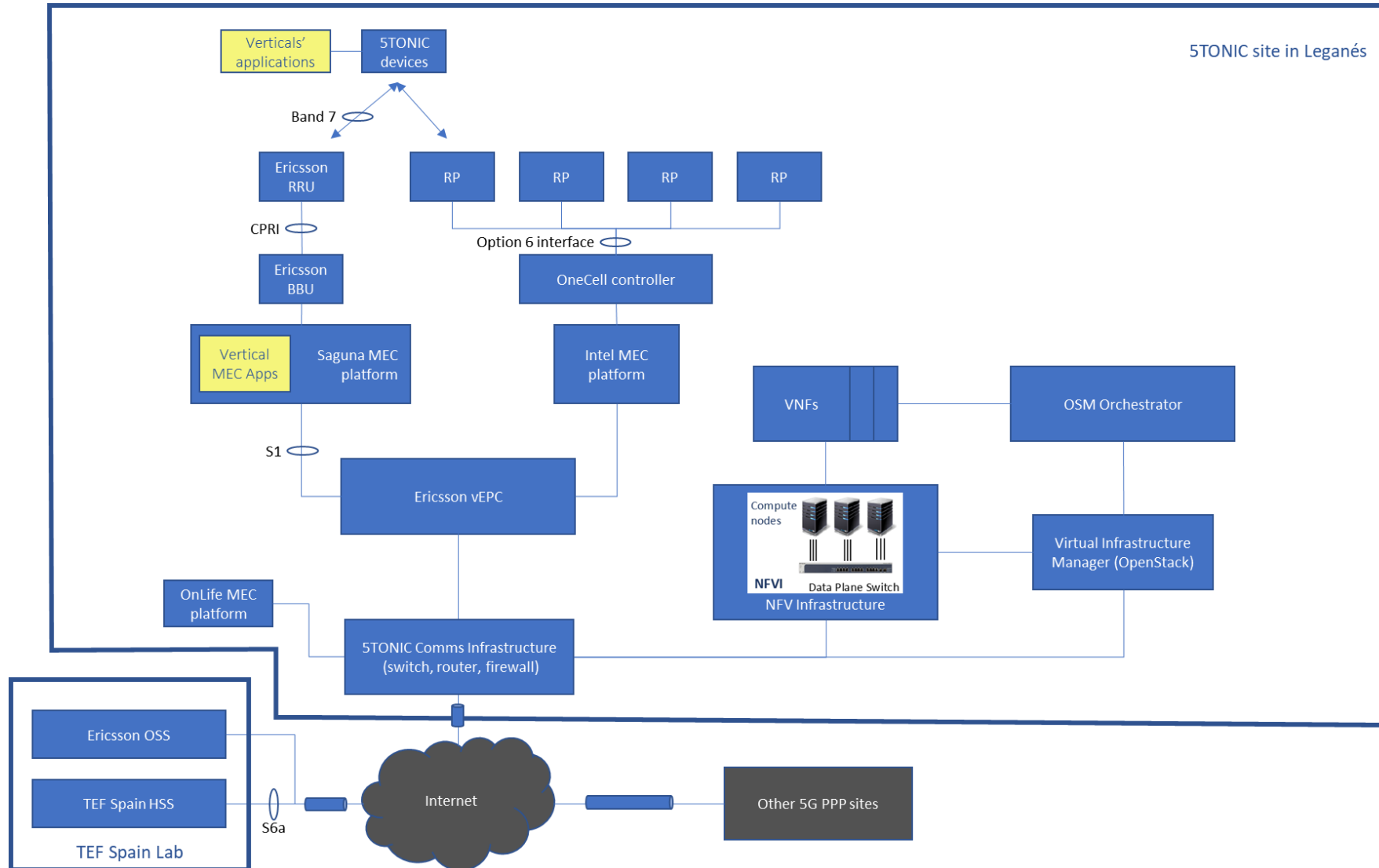# 5TONIC infrastructure

Other aspects:

- **Connectivity with RedIRIS**, the Spanish academic and research network that provides advanced communication services to the scientific community and national universities
    - 10 Gbit/s redundant connection

- **Indoor and outdoor facilities** at IMDEA Networks

- Agreement for accessing to **test and measurement equipment with Rohde & Schwarz**

- Acess to other facilities:
    - UC3M campus both at Leganés and Madrid City Center
    - Telefónica I+D lab at Almagro Central Office
    - Telefónica headquartes campus Distrito C
    - 5G IFEMA Lab at Feria de Madrid
    - Connection with Telefónica Spain lab at Alcobendas

8,5 m

11,5 m

■ Ethernet port
■ AC plug
■ Electric panel
⊢⊣ Rack for rectifier

5TONIC infrastructure

5TONIC infrastructure – current status

5TONIC site in Leganés

Verticals' applications — 5TONIC devices

Band 7

Ericsson RRU — RP — RP — RP — RP

CPRI

Option 6 interface

Ericsson BBU

OneCell controller

Vertical MEC Apps — Saguna MEC platform

Intel MEC platform

VNFs — OSM Orchestrator

S1

Ericsson vEPC

Compute nodes
NFVI — Data Plane Switch
NFV Infrastructure

Virtual Infrastructure Manager (OpenStack)

OnLife MEC platform

5TONIC Comms Infrastructure (switch, router, firewall)

Ericsson OSS

TEF Spain HSS

S6a

TEF Spain Lab

Internet

Other 5G PPP sites

5TONIC working procedures

5TONIC main technical activities are structured around **projects/trials**

- The projects/trials should be **approved by** the 5TONIC governing body, the **Steering Board** (decisions require simple majority of the members)

- Each trial involves **at least one 5TONIC member** and may include also **one or more collaborators**

- The **work plan, resources** committed (human and material), **location** and **dissemination** policy are agreed by the participants of the trial
  - There is a project manager in charge of coordinating each trial
  - The results from the trials may be kept confidential to those involved in them
  - Infrastructure not available at 5TONIC for the support of the trials should be provided by those involved in them

- The trial may be related to a **potential 5G use case** (which is the preferred option) or to the testing of a **5G technological component**

- 5TONIC provides **dedicated resources** (not only the lab infrastructure, but also two people with full dedication) for the support of the trials

- 5TONIC trials may be also **associated to European projects** the members participate in

Beyond technical activities , 5TONIC is also involved in **academic activities** (like the NFV/SDN master program), as well as **5G promotion and standardization activities**

Backup slides

5TONIC History

Created in 2015 by **Telefónica I+D and IMDEA Networks Institute** with a clear vision of setting up an **open research and innovation ecosystem laboratory** in which industry and academia come together to boost technology and business innovative ventures

Since then, several leading companies have become members and collaborators of 5TONIC, with a current roster of **10 members** and **5 collaborators**

5TONIC is chaired by **David del Val**, CEO of Telefónica I+D, and vice-chaired by **Arturo Azcorra**, Director of IMDEA Networks and Professor at U. Carlos III

The lab has been on the forefront of technological innovation and with an extensive track record in **European 5G Research Projects**

It is also responsible for the organization of the world's **first ETSI Plugtest of the NFV working group** (Jan 2017)

It has participated in different events, including **MWC 2018** and **FITUR 2018**, and has received several prizes in recognition to its activities

It has also been recognized as a **Digital Innovation Hub (DIH)** by the European Union (EU)

5TONIC Members and Collaborators

5TONIC members

5TONIC members steer all the activities of lab and contribute to its maintenance

Current 5TONIC members are:

1. **Telefónica**
2. **IMDEA Networks**
3. **Ericsson**
4. **University Carlos III Madrid**
5. **Intel**
6. **CommScope**
7. **Altran**
8. **Cohere Technologies**
9. **InterDigital**
10. **Red Hat**

5TONIC collaborators

Collaborators are involved in specific 5TONIC activities and have not decision capacity

Current 5TONIC Collaborators include:

1. **IFEMA**
2. **ASTI Robotics**
3. **Rohde & Schwarz**
4. **Luz Wavelabs**
5. **Saguna Networks**

Potential new collaborators include **Nokia**, **SEGITTUR**, **SAMUR** and **Anteral**

5TONIC activities

5TONIC activities can be classified into different sets:

Technical activities for the evaluation of 5G use cases

Objective:

Cooperate with verticals in the development of services and applications that may benefit from 5G innovations and may constitute new revenue streams for operators

Examples:

- Autonomous vehicles in industrial environments, in cooperation with ASTI Robotics
- Emergency services in cooperation with SAMUR
- Augmented reality services for fairs in cooperation with IFEMA
- REMOTIS project with Altran

Technical activities for the evaluation of 5G technical components

Objective:

Test and evaluate the new technical solutions proposed by 5TONIC members and collaborators, to identify those that may prove valuable for the evolution on 5G in areas like new radio technologies and virtualization and network slicing

Examples:

- New waveform OTFS trials with Cohere and Telefónica
- Cell-less RAN architecture OneCell with CommScope
- New high-frequency signal generation technology Luz Wavelabs
- Integrated fronthaul/backhaul with Ericsson and Telefónica

Technical activities related to European projects

Objective:

Provide support for the 5TONIC members in their activities in current projects, as well as become one of the main European testbeds for future 5G ICT projects

Examples:

- Hosting of the final review of the CrossHaul project, as well as intermediate review of 5G-Ex and 5GInFire
- Involved in the 3 large end-to-end trial projects of the EU ICT-17: 5G-EVE, 5G-VINNI and 5GENESIS

Dissemination and other activities

Objective:

Contribute to the dissemination of 5G capabilities to support new applications and use cases

Examples:

- 1st ETSI NFV plugfest
- Cooperation in the UC3M's Master of NFV and SDN in 5G Networks

5TONIC approach to vertical use cases

Rather than the traditional approach of demonstrating applications or use cases that are only feasible using 5G technology, 5TONIC is focusing on **use cases with potential short/medium term commercial applications**

The main elements of the strategy adopted are:

→ **Involving final users** in the development of the applications and services that make use of the 5G technology, to ensure that they provide real value for them

→ Ensuring that the implementation is based, whenever feasible, on **commercial/pre-commercial equipment** (rather than experimental one), so the economic viability of the solutions is more likely

→ Trying to involve **different partners** in the implementation of the use cases, rather than a single one,

→ Emulating, as much as possible, **realistic operational conditions**

→ Adopting a **phased approach** for the development of 5G based services and applications, adapted to the evolution of the technology

→ Trying to find **synergies with other 5TONIC activities**, like the participation in European projects

5TONIC approach to technology trials

The objective of the technology trials is to develop and validate the main enablers that will make 5G use cases feasible from a techno-economic viewpoint

Main focus has been put on:

- **Virtualization of the different network functions**, for both core and acess

- **Network slicing** for greater flexibility in the support of the requirements associated to different use cases

- I**ntegrated transport** for both backhaul and fronthaul

- Use of **high frequency bands**

- **New 4G features** that are part of the evolution towards 5G: pre-scheduling for lower latency, use of high order modulation for increased capacity, lean carrier operation for inter-cell interference reduction, cell-less mobility,…

5TONIC is also looking at potentially **disruptive technologies** that may be part of the 5G evolution:

→ **OTFS**, a new waveform that provides (more than 50 bit/s/Hz of spectral efficiency measured in live tests carried out at Telefónica headquarters)

→ New antenna technologies for high frequency bands: LCD antenas, lens antennas

→ New signal generation technology based in optical processing

5TONIC participation in European projects

Providing support for the 5TONIC members in their activities in current projects

Involved in the 3 large end-to-end 5G trial labs funded by the EU ICT-17
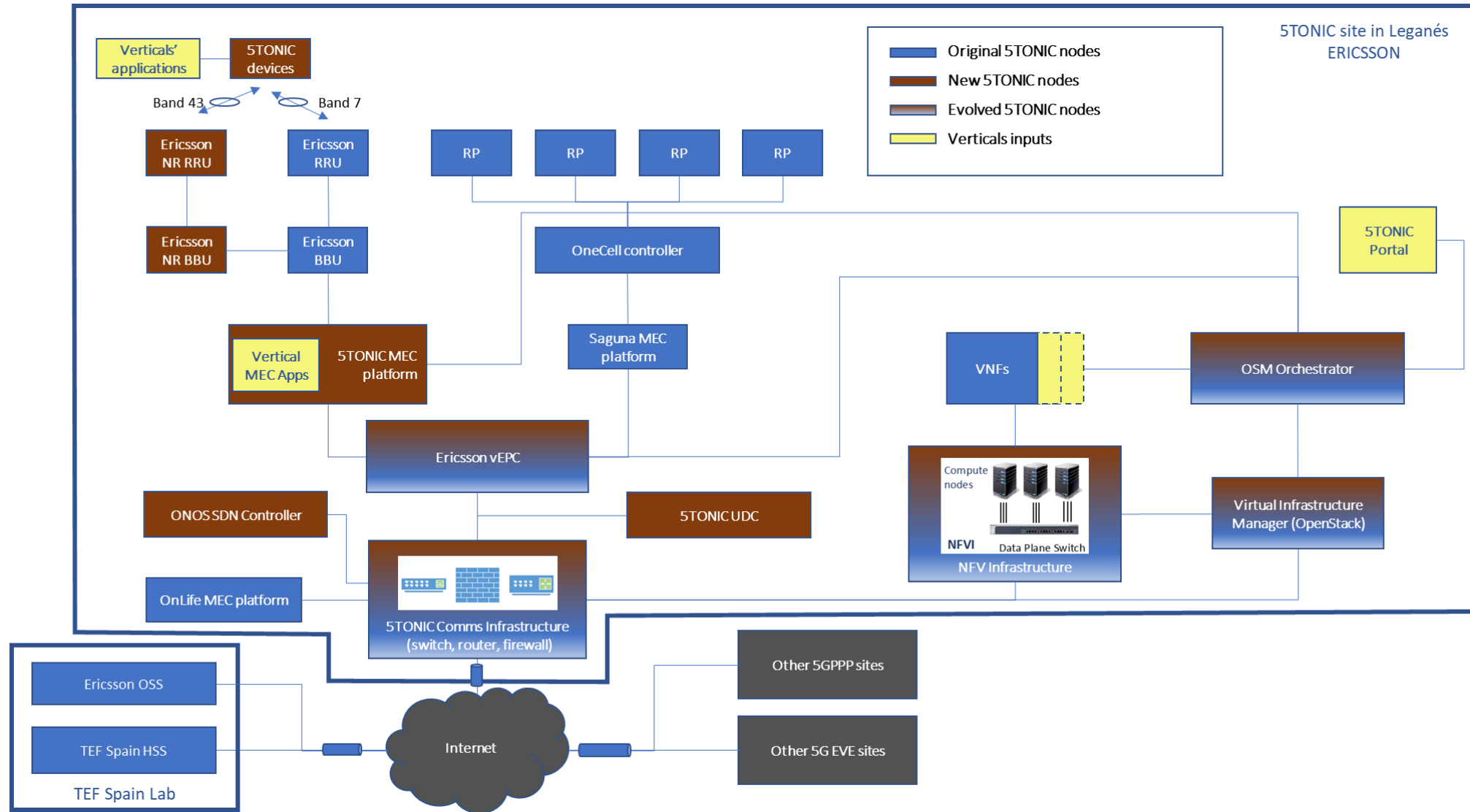
Participating in other relevant projects and calls:

- EU-Brasil:

- EU-Taiwan:

5GENESIS

5TONIC infrastructure – expected evolution

Thanks