UC/DEEC & ALB
Projecto 2

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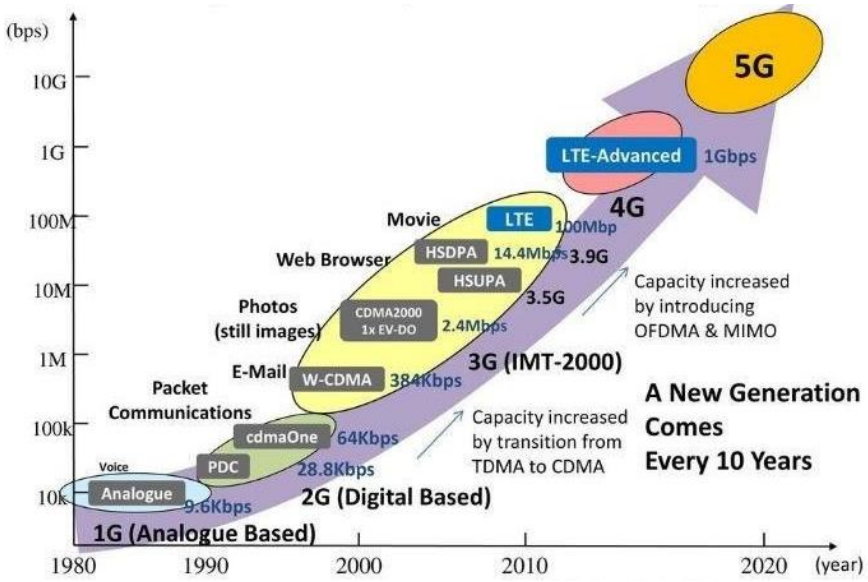
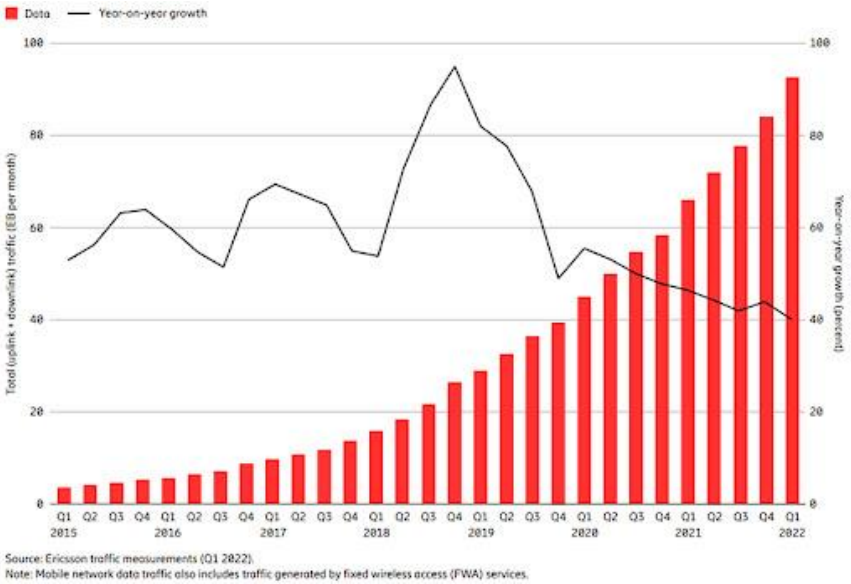
altice labs

Technological waves

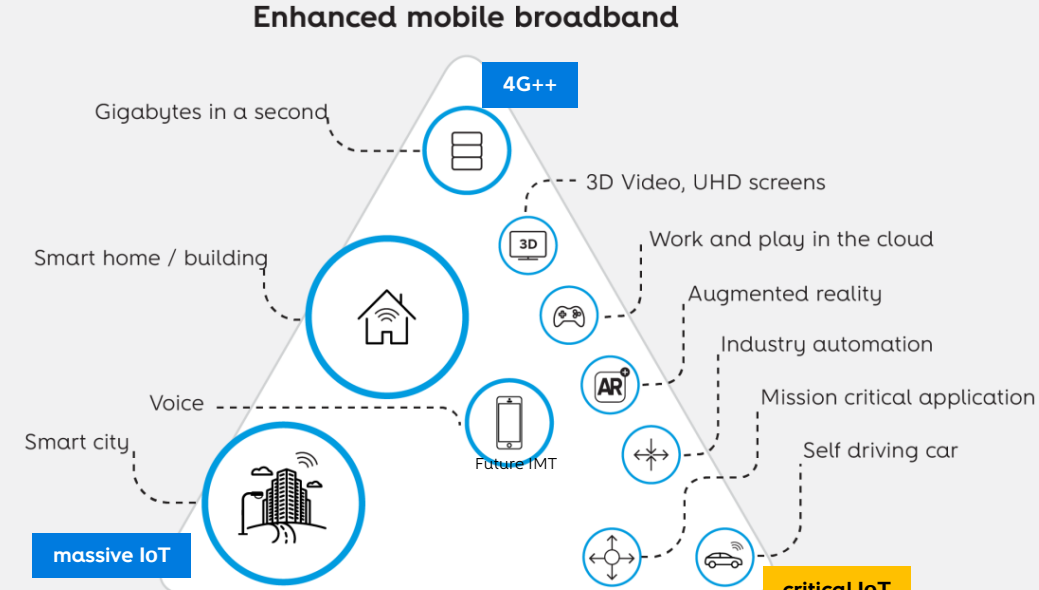
1G	2G	3G	4G	5G
Mobile voice communication	Digital mobile voice SMS/MMS	Broadband mobile data	Broadband mobile data massification	Unified future-proof platform
1980	1990	2000	2010	2020
Analogue voice C450, NMT, AMPS, TACS	D-AMPS, GPRS, GSM, SMS/MMS, CDMA Data < 128 Kbps	UMTS/CDMA2000, HSPA+, Smartphones Data < 42 Mbps	LTE, LTE Advanced, Gigabit LTE, OFDM Data < 1 Gbps	5G New Radio, SDN, NFV, ML/AI eMBB 10 Gbps
Analogue system Copper cables	PSTN, X.25, Frame Relay, ATM, DOCSIS	xDSL, IP/MPLS, Digital Television, SD Video	IMS, VoLTE, IoT, IPTV, GPON/FTTH, Cloud, Vídeo HD	Massive MIMO, Beam forming, Slicing, mIoT, XGS-PON, Ultra HDTV

Technologies and usage evolution





5G organization of ‘Usage Scenarios’



5G will power a **new generation of services and applications** in the areas of:

Enhanced Mobile BroadBand (eMBB)
Make it faster!

Massive Machine Type Communications (mMTC)
Make it massive!

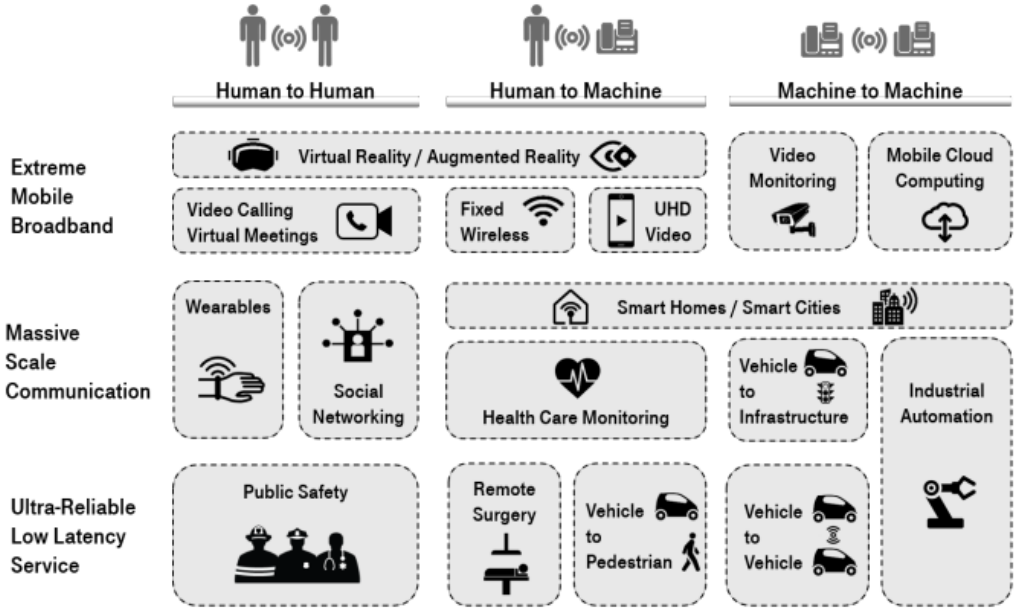
Ultra-Reliable, Low Latency Communications (URLCC)
Make it trustable and responsive!

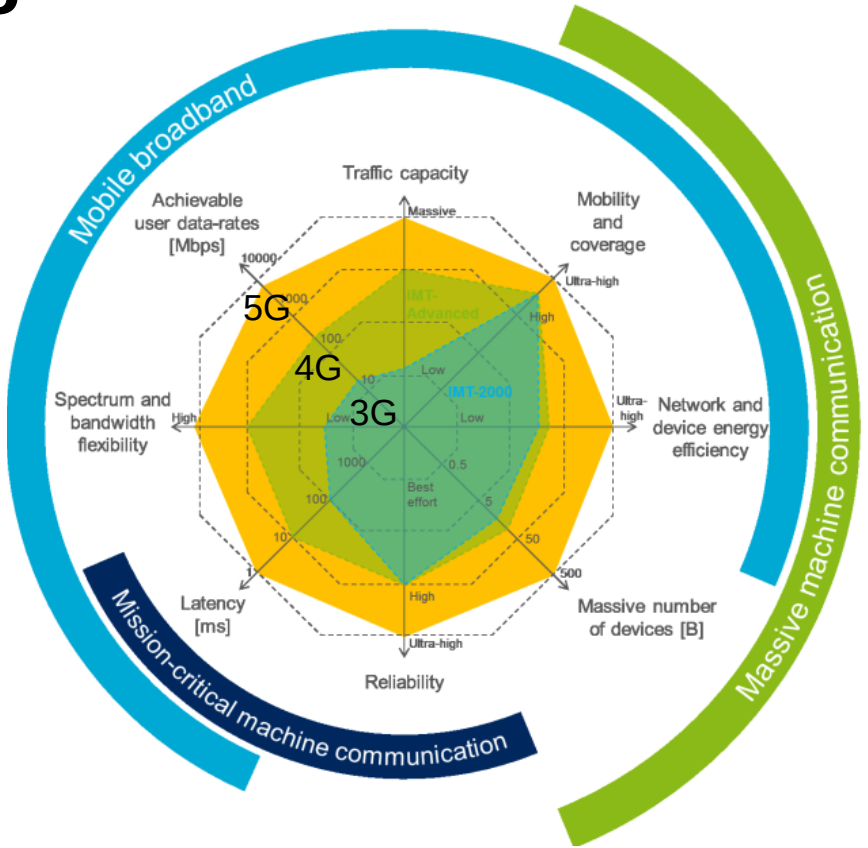
All with a single, unified technology

A trillion of devices with different needs	GB transferred in an instant	Mission-critical wireless control and automation

…while driving down the cost per managed bit

5G organization of usage scenarios

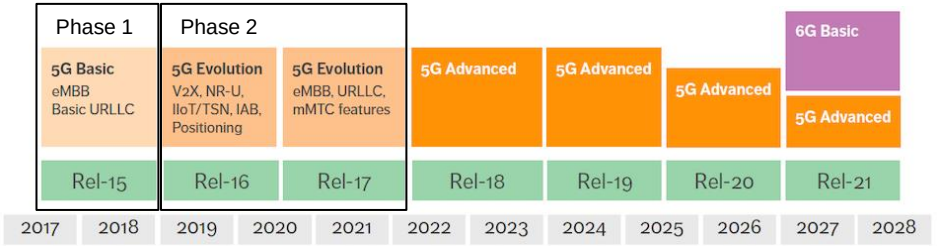


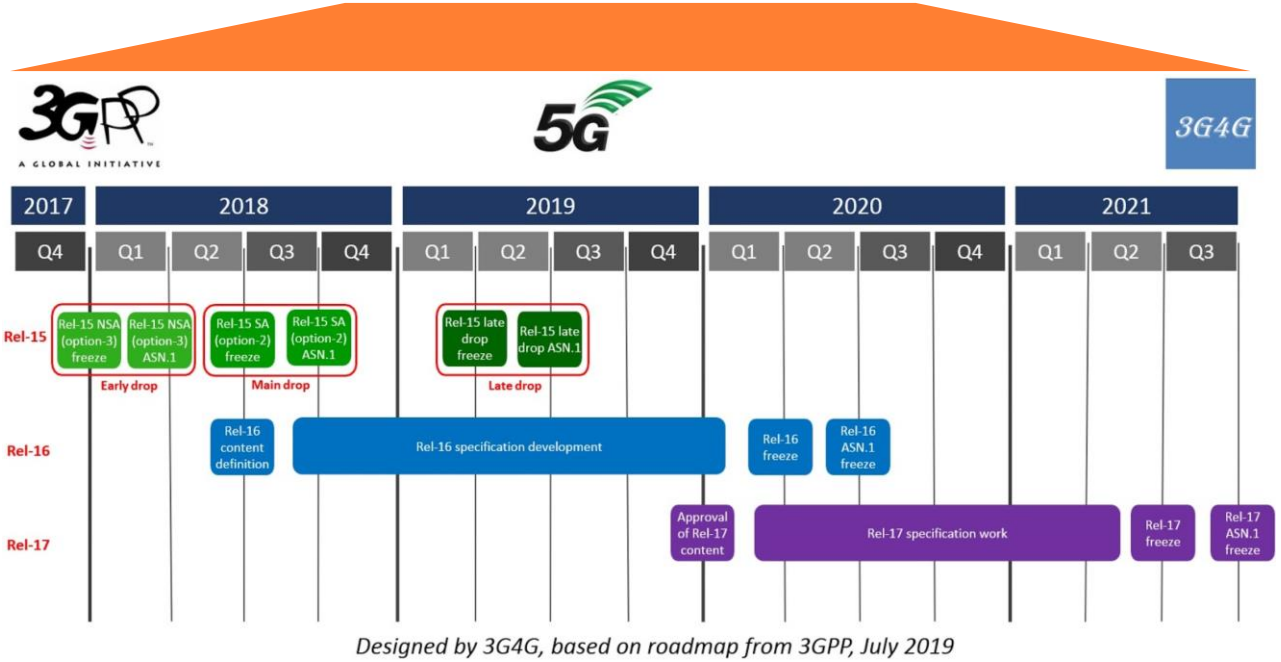


Reinforce B2C, embrace B2B

5G: From Research to Standardisation, http://www.irisa.fr/dionysos/pages_perso/ksentini/R2S/pres/Bernard-EC-Panel-R2S-2014.pdf

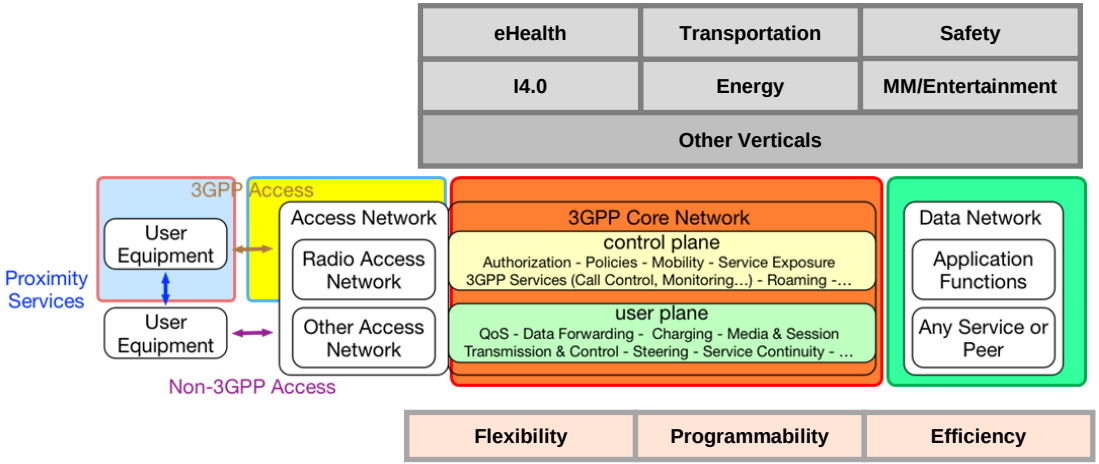
5G roadmap

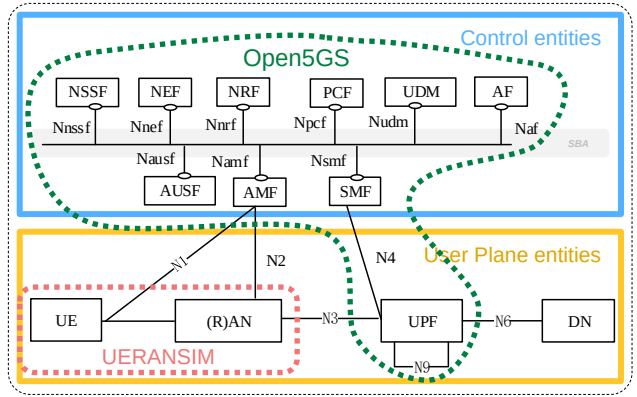




Designed by 3G4G, based on roadmap from 3GPP, July 2019

5G main building blocks





Based on a **new, unified, air interface** (*New Radio: NR* - ***5G-NR***) and a **new network architecture**, to connect everything

5G *New Radio* (NR) to "connect everything":

•A **<u>unified air interface</u>**

You will be seeing 5G NR connectivity in your smartphones, cars, utility meters, wearables and much more (Qualcomm)

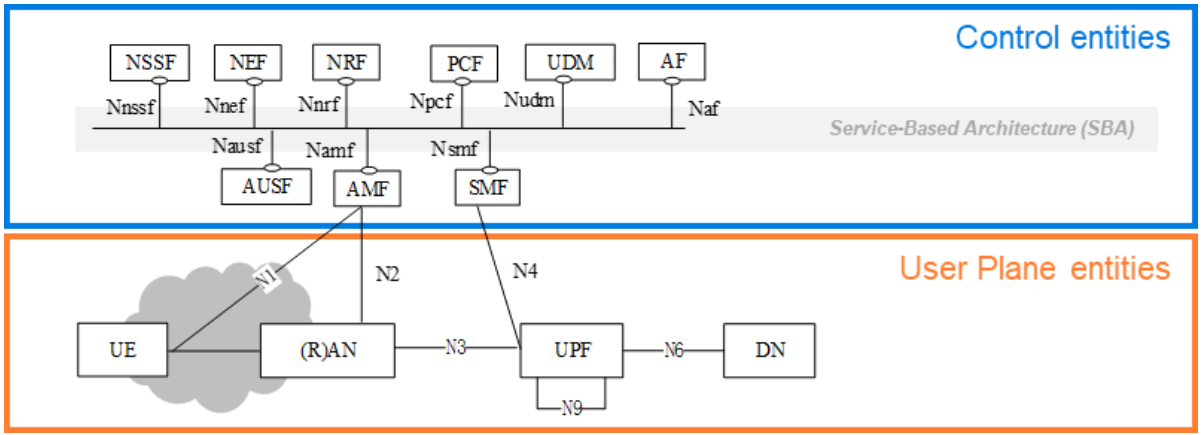
Able to **embrace all sort of wireless/wired accesses**, sharing a common core (*5G Core Network – **5GC***)

5G new architecture to "interconnect everything":

•A **<u>common core network</u>**

The new architecture shall support at least the new RAT(s), the Evolved E-UTRA, non-3GPP accesses and minimize access dependencies (3GPP TR 23.799)

5G System arch. and functional modules (parcial)



1. Network Slice Selection Function (NSSF)
2. Network Exposure Function (NEF)
3. NF Repository Function (NRF)
4. Policy Control Function (PCF)
5. Unified Data Management (UDM)
6. Application Function (AF)

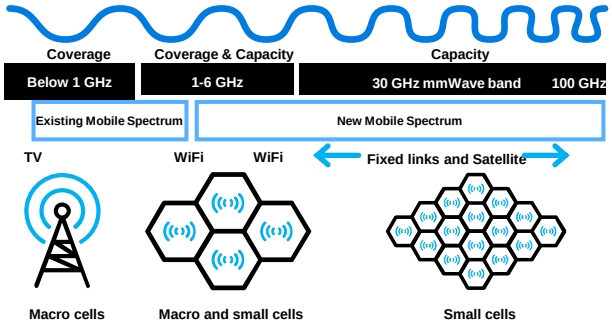
7. Authentication Server Function (AUSF)
8. Access and Mobility Management Function (AMF)
9. Session Management Function (SMF)

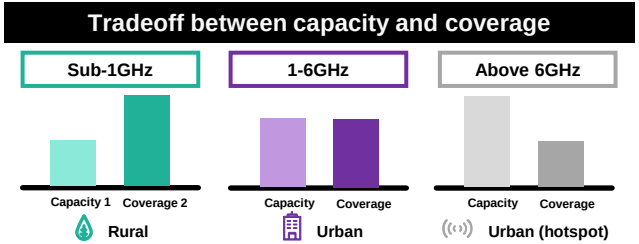
10. Unified Data Repository (UDR)
11. Unstructured Data Storage Function (UDSF)
12. 5G-Equipment Identity Register (5G-EIR)
13. Security Edge Protection Proxy (SEPP)
14. Network Data Analytics Function (NWDAF)

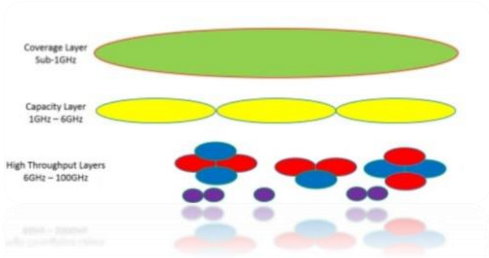
1. User Equipment (UE)
2. (Radio) Access Network ((R)AN)
3. User Plane Function (UPF)
4. Data Network (DN)

- **Separate the User Plane (UP) functions from the Control Plane (CP) functions**
- **Modularize the function design**, e.g. to enable flexible and efficient network slicing
- **Define procedures** (i.e. the set of interactions between network functions) **as services**
- Enable each Network Function to interact with other NF directly if required (**direct interaction**)
- **Minimize dependencies between the Access Network (AN) and the Core Network (CN)**
- Support a **unified authentication framework**
- Support **"stateless" NFs**, where the "compute" resource is decoupled from the "storage" resource
- Support **capability exposure**
- Support **concurrent access to local and centralized services**. To support low latency services and access to local data networks, **UP functions can be deployed close to the Access Network**

Larger spectrum usage to cover all applications



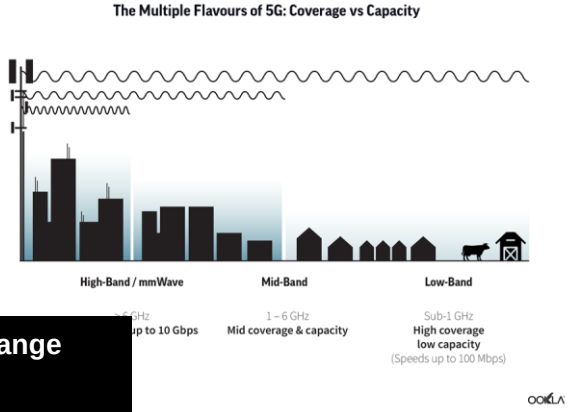




Universal coverage (10's of Mb/s) of reliable connectivity

Urban coverage with dense small cells (1-3 Gb/s) e.g. mobile Gb/s society, smart cities, option for connected highways

Hot spots coverage (up to 10 Gb/s) e.g. fixed wireless access, railway stations, sport events, smart factories,

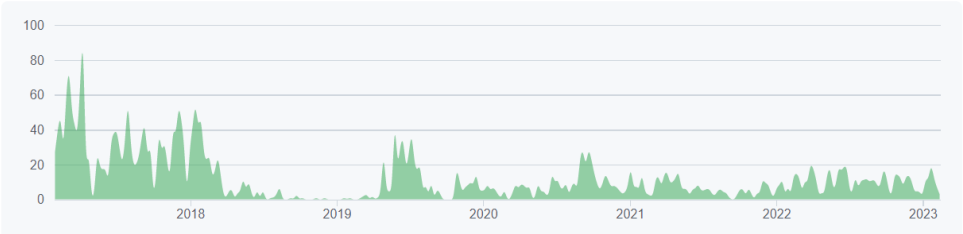


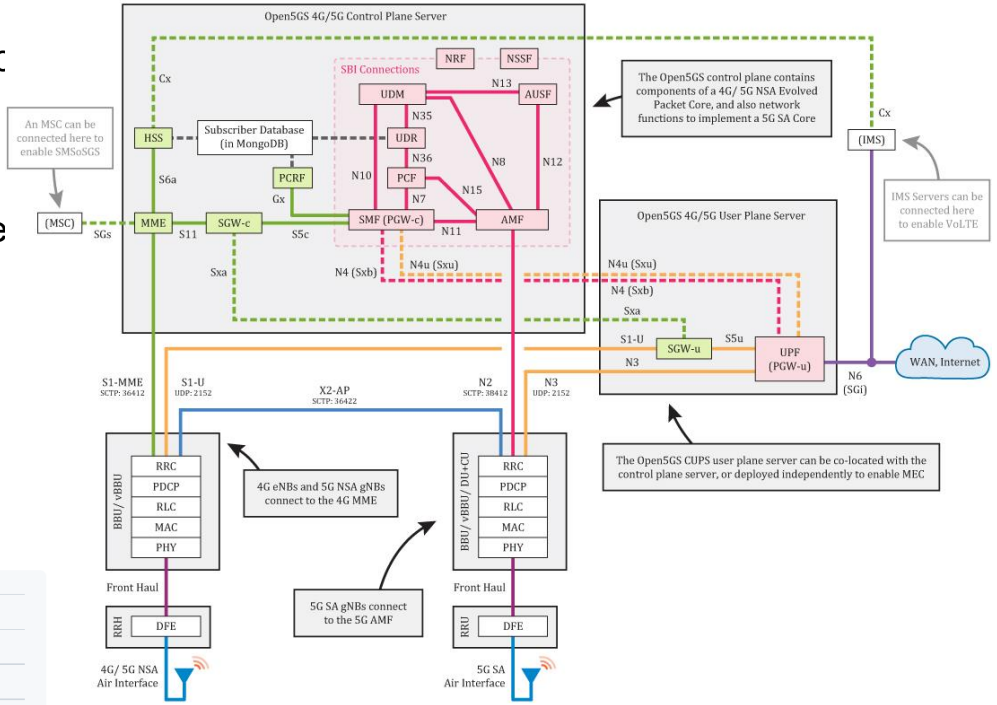
5G-NR to operate on a larger spectrum range

- Expanding to lower freqs. for coverage and penetration
- Expanding to higher freqs. for capacity and low latency

Open5GS

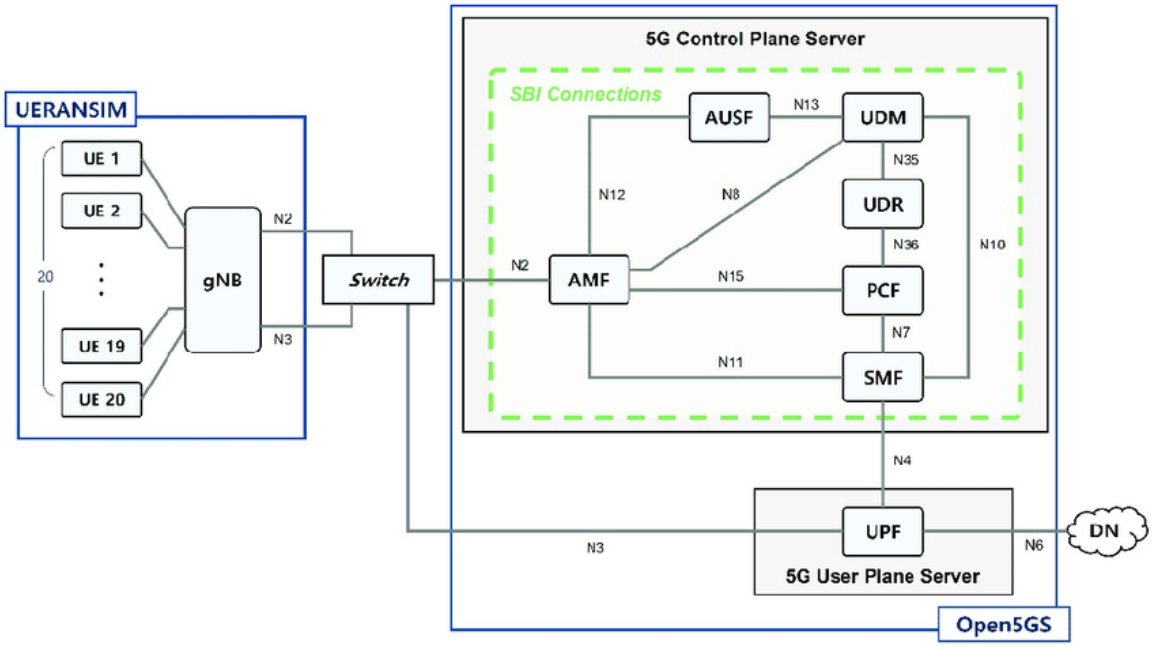
- State of the art open-source 5G (and 4G) core written in C
- Compatible with Release 16 (soon release 17)
- Frame routing functionality is natively supported (sinc last month)
- Great community, sponsored by research institutes and some SMEs
- Doesn’t require any special hardware, can be installe on a simple VM (plus other advanced deployments)
- Implements multiple network functions (SMF, UPF, AMF, UDM, PFC, etc..); enough for a 5G SA deployment
- Tested by Altice Labs with commercial RAN stacks
- Live project



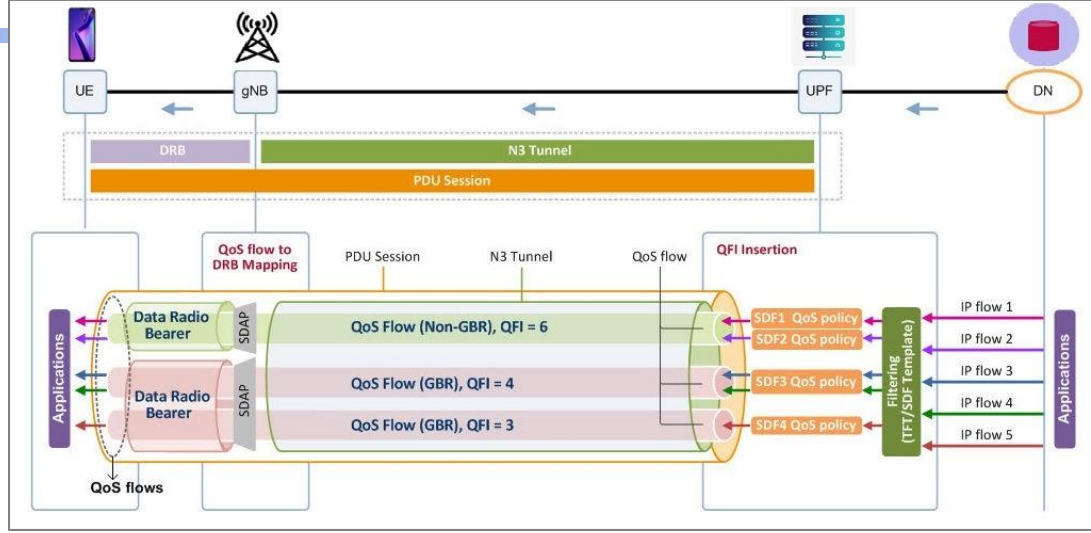


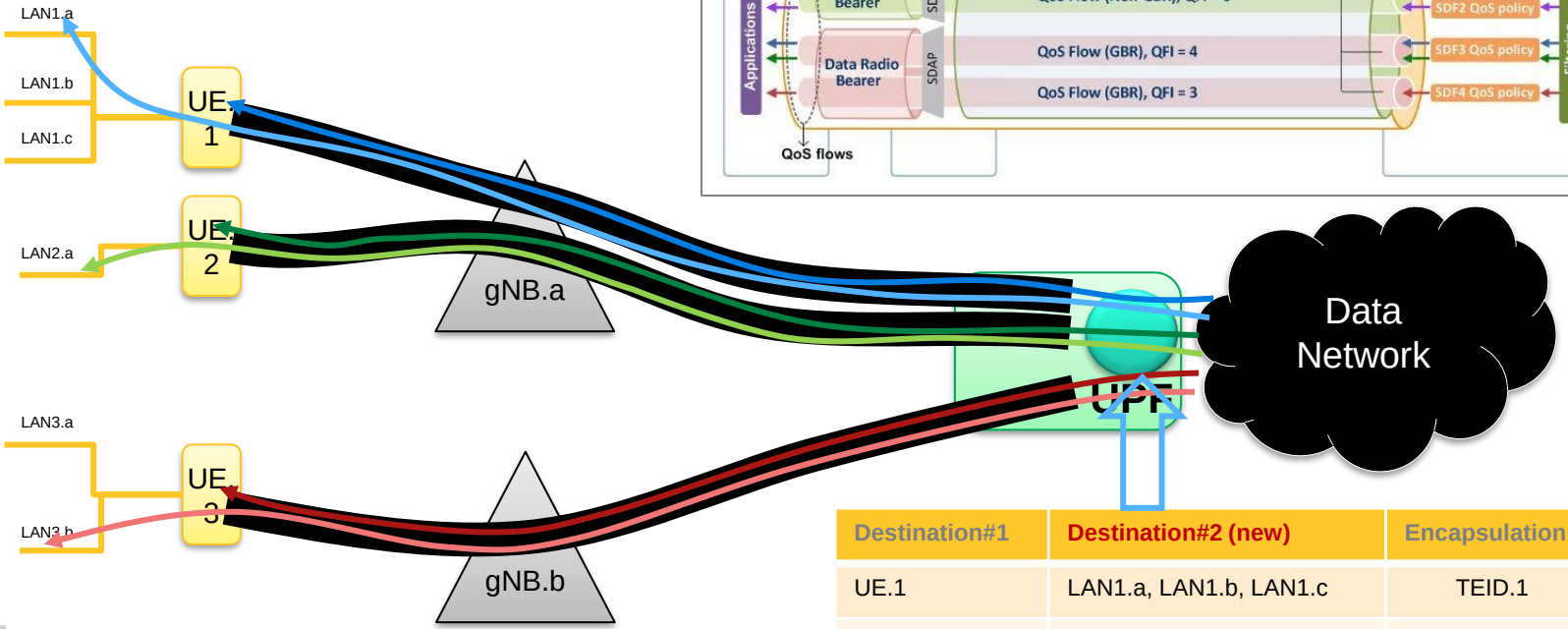
UERANSIM

- RAN and UE emulator
- Does not emulate the radio physical layer. The 5G-NR radio interface is simulated over UDP
- Creates Linux TUN interfaces for the emulated UEs (just like any other network interface on the machine)
- Can also be simply installed on a simple VM to estimulate and test the 5G core 3GPP procedures



Framed Routing





Destination#1	Destination#2 (new)	Encapsulation
UE.1	LAN1.a, LAN1.b, LAN1.c	TEID.1
UE.2	LAN2.a	TEID.2
UE.3	LAN3.a, LAN3.b	TEID.3

Sub-projectos

1. Adição da gestão da sub-redes no WebGUI

1. Configuração do router móvel 5G via TR-069

1. Adição da feature Framed Route no UPG TravelPing

Project Proposal 1

Project Title: 5G Framed Route

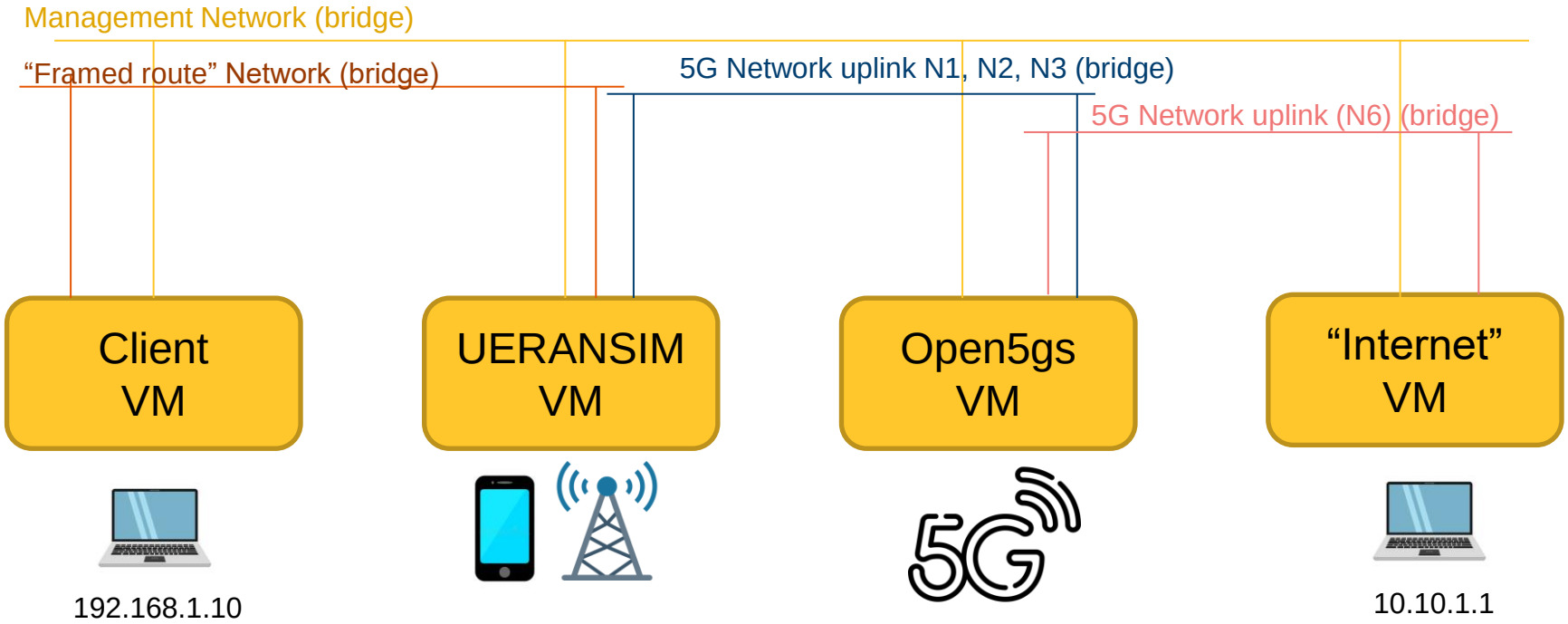
Motivation:

Framed routing is a recent functionality of Open5gs. It has not yet been validated/tested by Altice Labs. Management/provision operations are still incomplete on the core. Monitoring such networks can be a challenge.

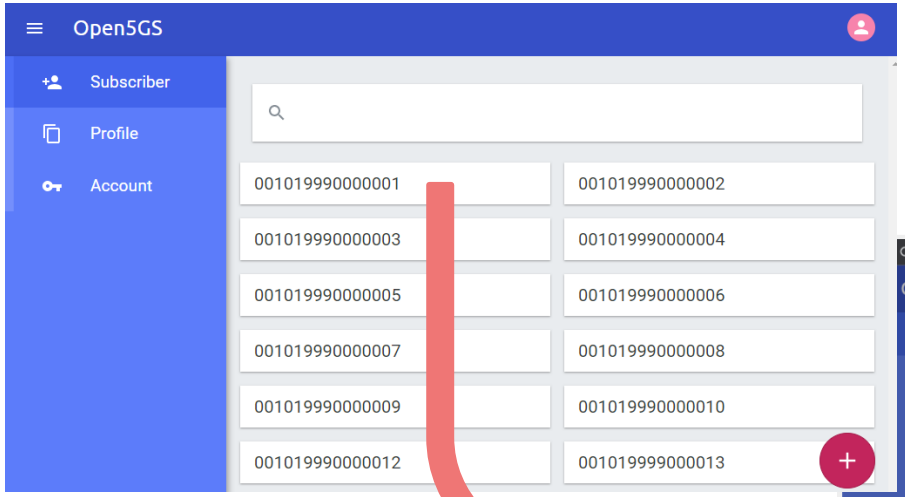
Sub-Project Goals/Tasks:

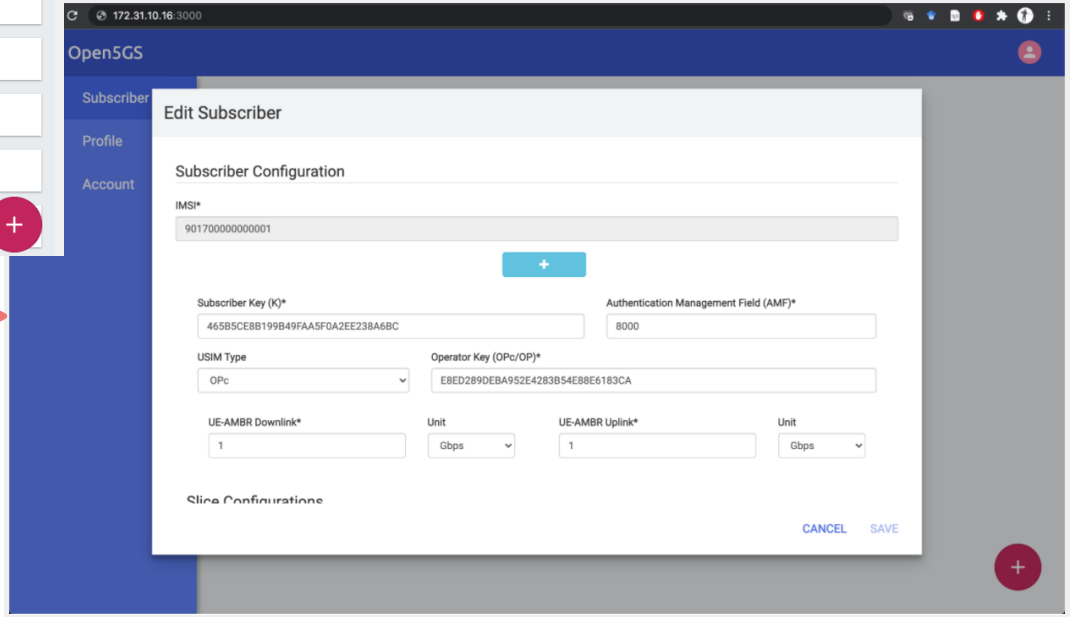
- Validate framed routing functionality in a state-of-the art open-source 5G core implementation (Open5GS), by setting up an emulated environment (e.g. VirtualBox/vagrant)
- Validation should be done end-to-end, i.e. from an emulated client behind an emulated 5G UE to the internet/N6 (both IPv4 and IPv6 prefixes)
- Investigate 3GPP standardized northbound APIs (e.g. CAPIF) to validate whether the Open5Gs UE provision API is aligned with current standards (and possible framed route “touch points”)
- Improve/develop the management web-interface of the 5G core by adding support for static framed route provisioning (currently only available in cli/db tools)
- Check and improve possible validations for overlapping routes
- Investigate 3GPP standards for possible options for framed route monitoring/charging (e.g. PFCP Session Report requests/response)
- Validate the scenario on a real 5G network (Altice Labs campus)
- Bonus points: contribute the code/feature upstream (if no one submits it earlier…)

Project Proposal 1



Project Proposal 1 – Open5GS WebGUI





Project Proposal 2

Project Title: 5G Framed Route

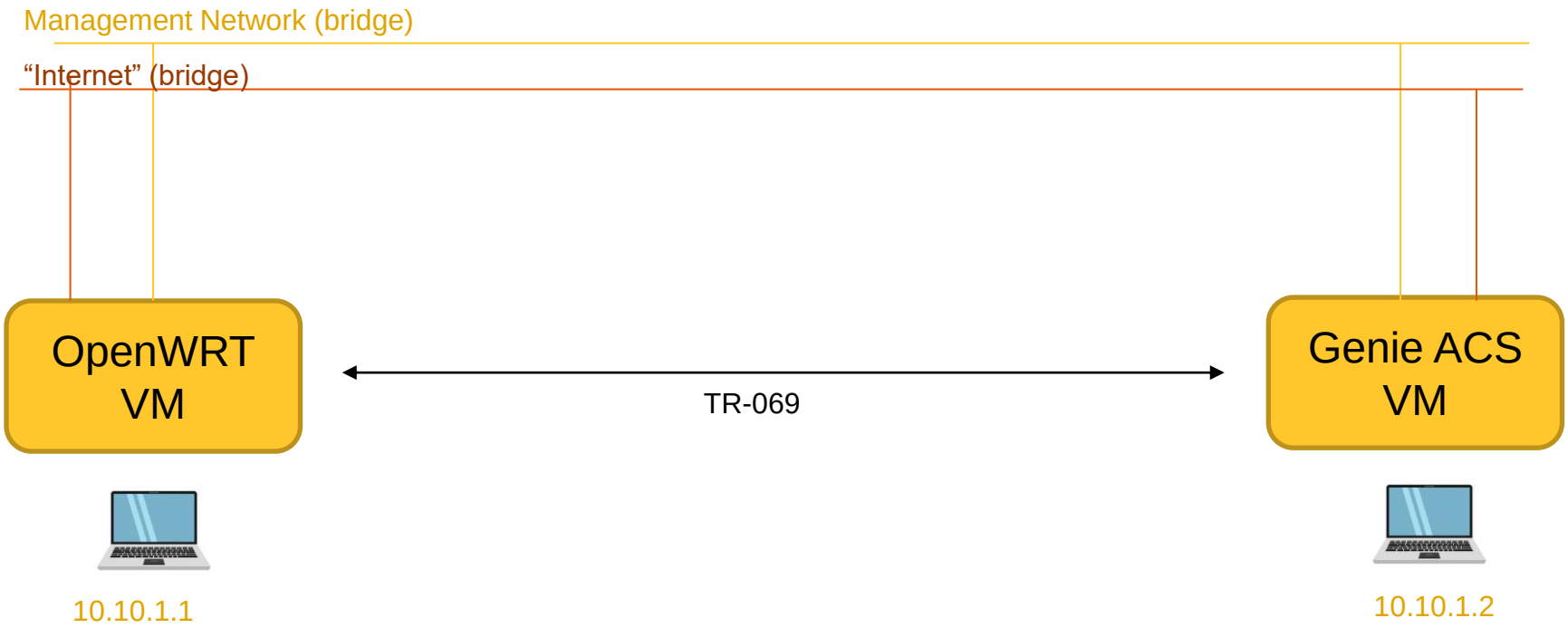
Motivation:

UEs/CPEs behind the 5G core are not made aware (according to 3GPP standards) of the framed route prefixes they are in charge of. As an operator, there is the willing of centrally manage the routes that should be configured in CPEs. Operators usually perform such tasks by employing auto configuration servers (ACS) on their network. When the CPE establishes the network session/lease it contacts the ACS server for auto-configuration via the TR-069 protocol.

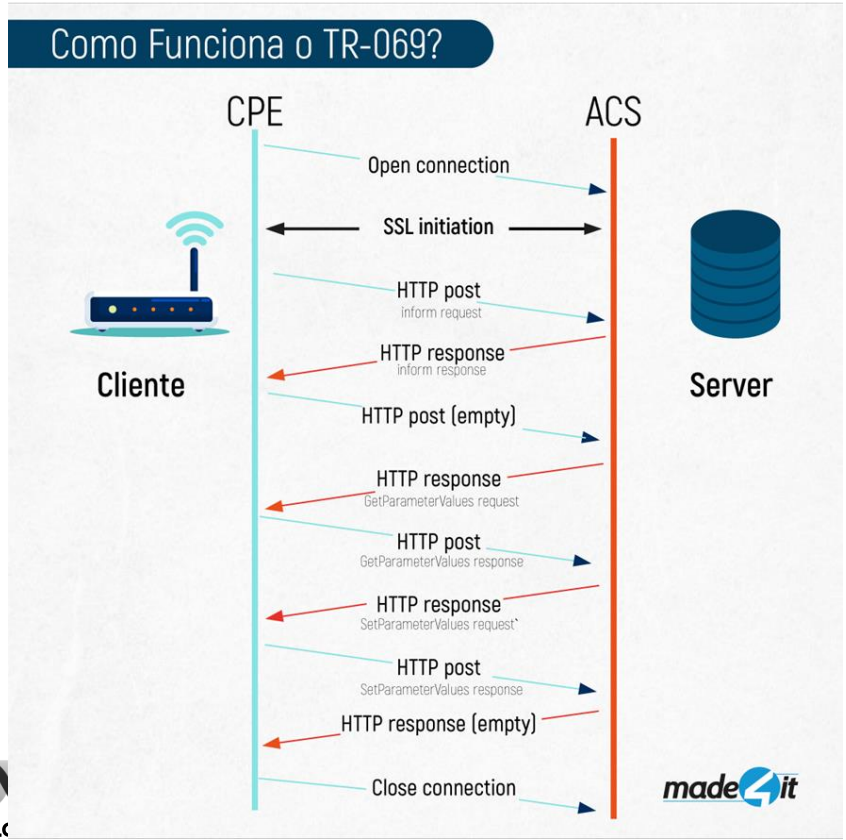
Sub-Project Goals/Tasks:

- Prototype a scenario, using open-source software, in which a CPE is bootstrapped with the framed route prefixes allocated by the operator for that particular CPE.
- Study the TR-069 data model to propose the best object to carry routing information to the CPE
- Create an autoconfiguration script that should be executed by the ACS (e.g. Genie ACS) when the UE contacts the ACS server
- Study possible ways for the Operator to take advantage of the ACS webinterface for provisioning routes to clients/CPEs
- Integrate the CPE (OpenWRT) with the ACS server to receive the operator configured routes
- Investigate and develop a way of triggering the ACS request once the network interface of the CPE gets an IP Address
- Validate the scenario on a real 5G network (Altice Labs campus), using one of our 5G CPEs.
- Nice to have: synergies with project 1 to combine the developments on top the of actual 5G emulated network

Project Proposal 2



Project Proposal 2



Client: OpenWRT (preferably) or any other Linux distribution. Use easycwmp as TR-069 client.

Server: Feel free to use any ACS server implementation. Suggestion (not mandatory): Genie ACS

Project Proposal 3

Project Title: 5G Framed Route

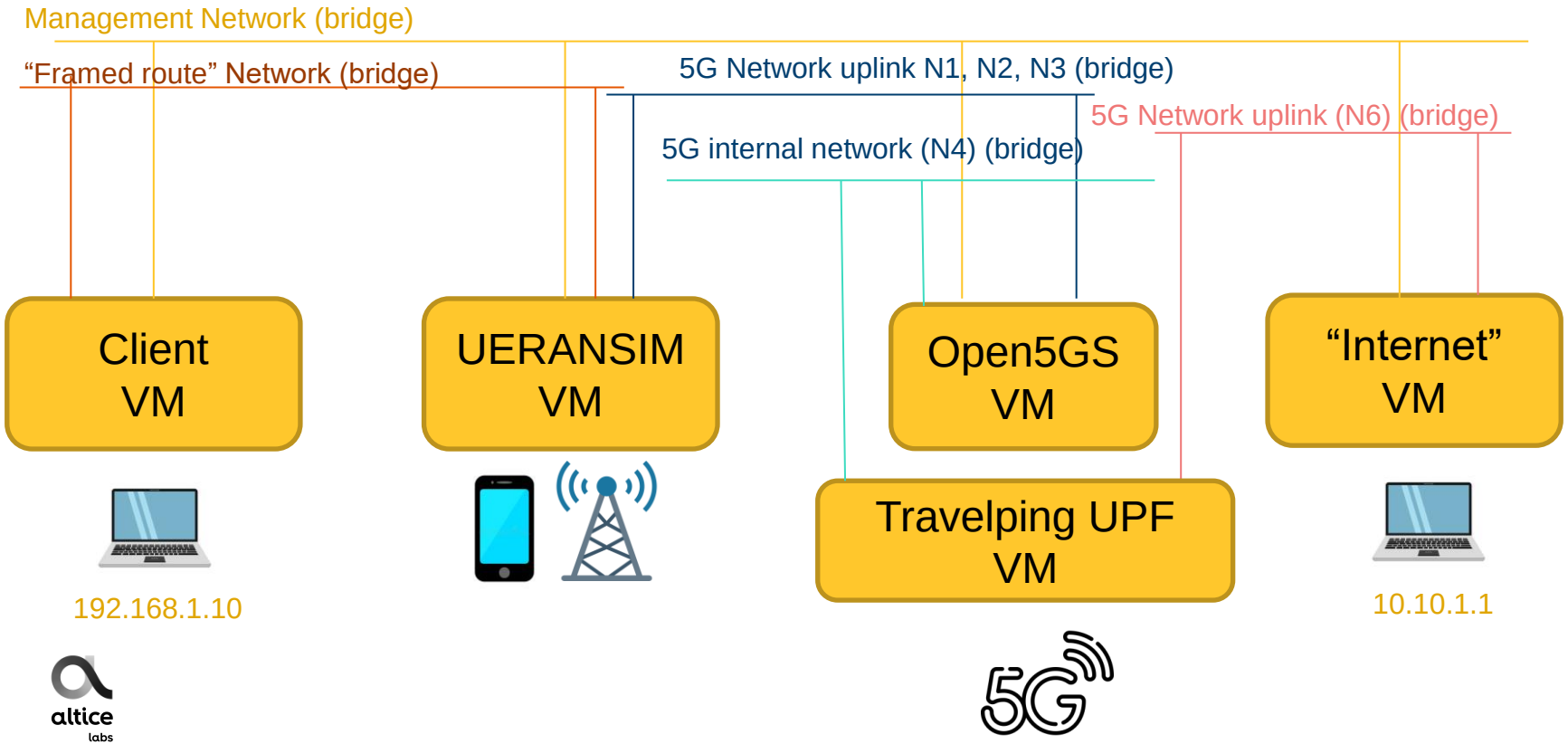
Motivation:

Monitoring traffic for devices behind the 5G UE/CPE (those that have access to the internet in the scope of framed routes) is challenging. 3GPP does not standardize an interface for 5G core network functions to collect traffic measurements from the data plane/UPF, stating such data should be provided by the operations and management platform (not standardizing the way the data actually gets there). One of the possible ways of collecting data from network equipment is to rely on streaming telemetry protocols (like IPFIX, sflow, etc). Travelping UPG-VPP is an open-source implementation of an UPF that supports IPFIX record collection for 5G traffic flows. Altice Labs has been using this UPF sucessfully in combination with Open5Gs for near real time traffic observability. **Unfortunately, this UPF lacks support for framed routing.**

Sub-Project Goals/Tasks:

- Prototype a simulation and development 5G environment using UERANSIM, Open5GS and the travelping UPF. Bonus points if the environment can be provided by the group working on project 1 (as the environment itself is out of the scope of this project)
- Develop the framed route feature on the travelping UPF using a similar approach to that followed by the builtin UPF of open5gs
- Validate the scenario on a real 5G network (Altice Labs campus). Altice labs will include the results of this work on its campus deployment (where a more complex and “network accelerated” environment exists).
- Bonus points: contribute the code/feature upstream

Project Proposal 3



Project Proposal 3

Note: Altice Labs may help setting up the environment (and the configuration of the UPF) to speed up development

The 5G core uses the PFCP protocol to configure the UPF. Since Open5Gs already supports the functionality, all the IEs for framed routing are already transmitted to the UPF.

Referências

[1] BBF, TR-470, 5G Wireless Wireline Convergence Architecture
[2] 3GPP, TS 23.501
[3] 3GPP, TS 23.502
[4] 3GPP, TS 29.503
[5] IETF RFC-2865, https://datatracker.ietf.org/doc/rfc2865/
[6] https://open5gs.org/open5gs/docs/guide/01-quickstart/
[7] https://github.com/open5gs/open5gs
[8] https://genieacs.com/
[9] https://github.com/aligungr/UERANSIM/wiki

https://github.com/open5gs/open5gs/pull/2009