ELDORADO OPENLAB

OpenRAN and SDR: an approach to build Open Mobile Networks

OpenAirInterface 2021 Summer Virtual Workshop

AGENDA

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INTRODUCTION

My name is Jose Antonio Mechaileh. I am the manager of the Mobile Network LAB at the Brazilian Eldorado Institute.

Eldorado Institute is a civil, non-profit research and development institute, with more than 20 years working with Software, Hardware, Energy, Microelectronics, Education, IT/Telecom, Agribusiness, Oil&Gas, Health, Automotive, among others areas.

Abstract:

Considering the disruptive technologies of OpenRAN, SDR, Virtualization and Cloudification we are building an open network lab, aiming to create 4G/LTE and 5G/NR networks, operating in midwave (sub-6) frequencies, using SDR technology.

The core network, the orchestration and general management of this environment will be done using open-source SWs.

Evolving this lab, we will migrate it into a virtual environment and then into a cloud implementation.

HIGHLIGHTS

- This project aims to implement a HW & SW environment for both real 4G LTE and 5G NR mobile networks, using an architecture built using COTS (commercial-off-the-shelf) hardware and open software, mainly OAI (Open Air Interface).

- The Eldorado OpenLAB is a flexible, remotely accessible, end-to-end software defined platform, supporting a range of wireless & mobile research. It creates the necessary ecosystem to be used as the basis for other developments, such as Edge Computing, C-V2X, IoT, AI, among others.

- This lab follows, as much as possible, the architecture and the technical concepts of the O-RAN Alliance and uses SDR (SW Defined Radio) technology for the radio part. The OpenRAN and SDR approach create a new paradigm, making the development & deployment of mobile solutions more flexible and at a lower cost.

OPEN AIR INTERFACE

SDR Software-Defined-Radio

OpenRAN

PROJECT PHASES

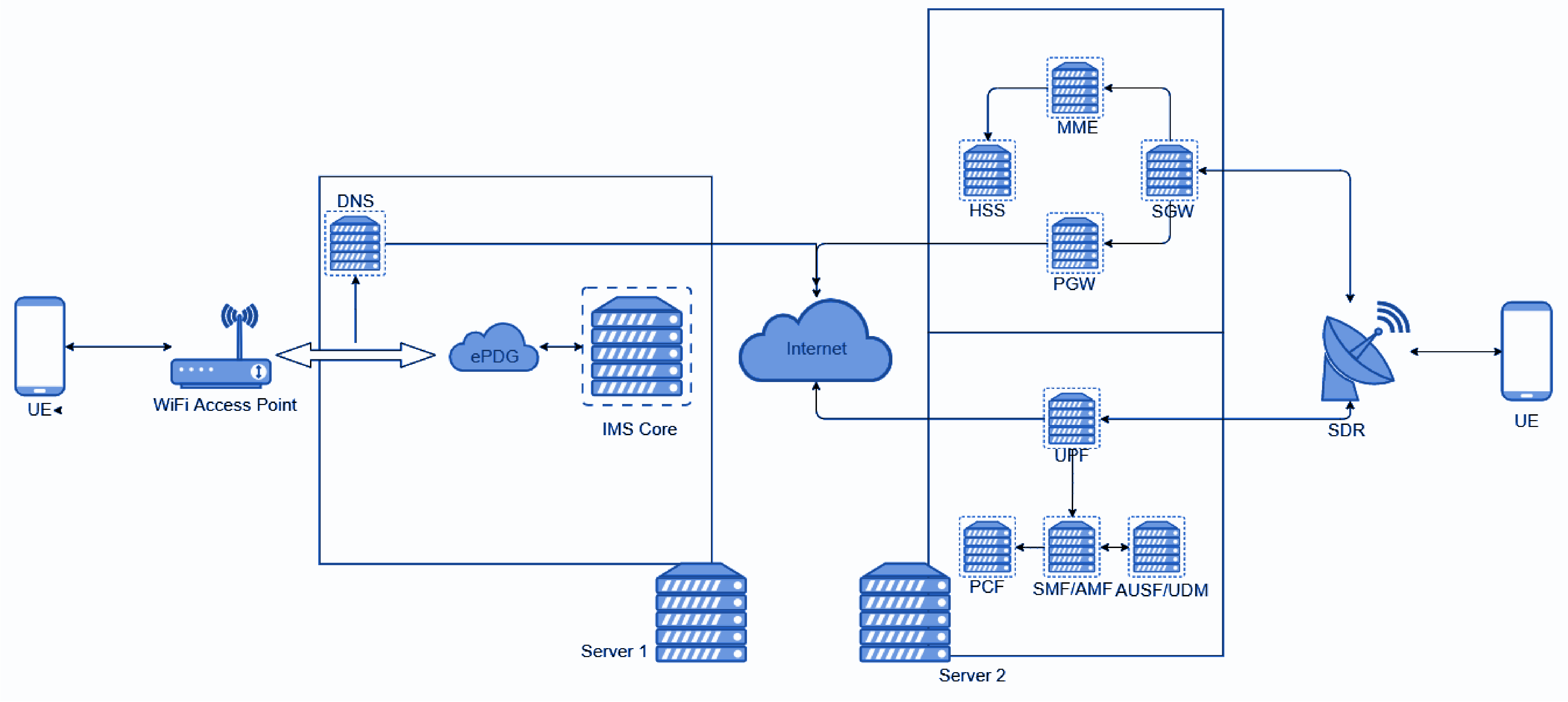
Phase 1: the first phase of this project aims to implement 4G and 5G networks through the use of commercial equipment (x64 servers) and open source software, as will be detailed described during this presentation.

Phase 2: the second phase of this project will virtualize the network elements through the use of containers and virtual machines. Virtualization uses software to create an abstraction layer over computer hardware that allows the hardware elements of a single computer—processors, memory, storage and more—to be divided into multiple virtual computers, commonly called virtual machines

Phase 3: the third phase of this project aims to evolve the IT infrastructure towards the cloudification of the network elements, migrating from the installations on the local premises to a web-based, commercial cloud service.

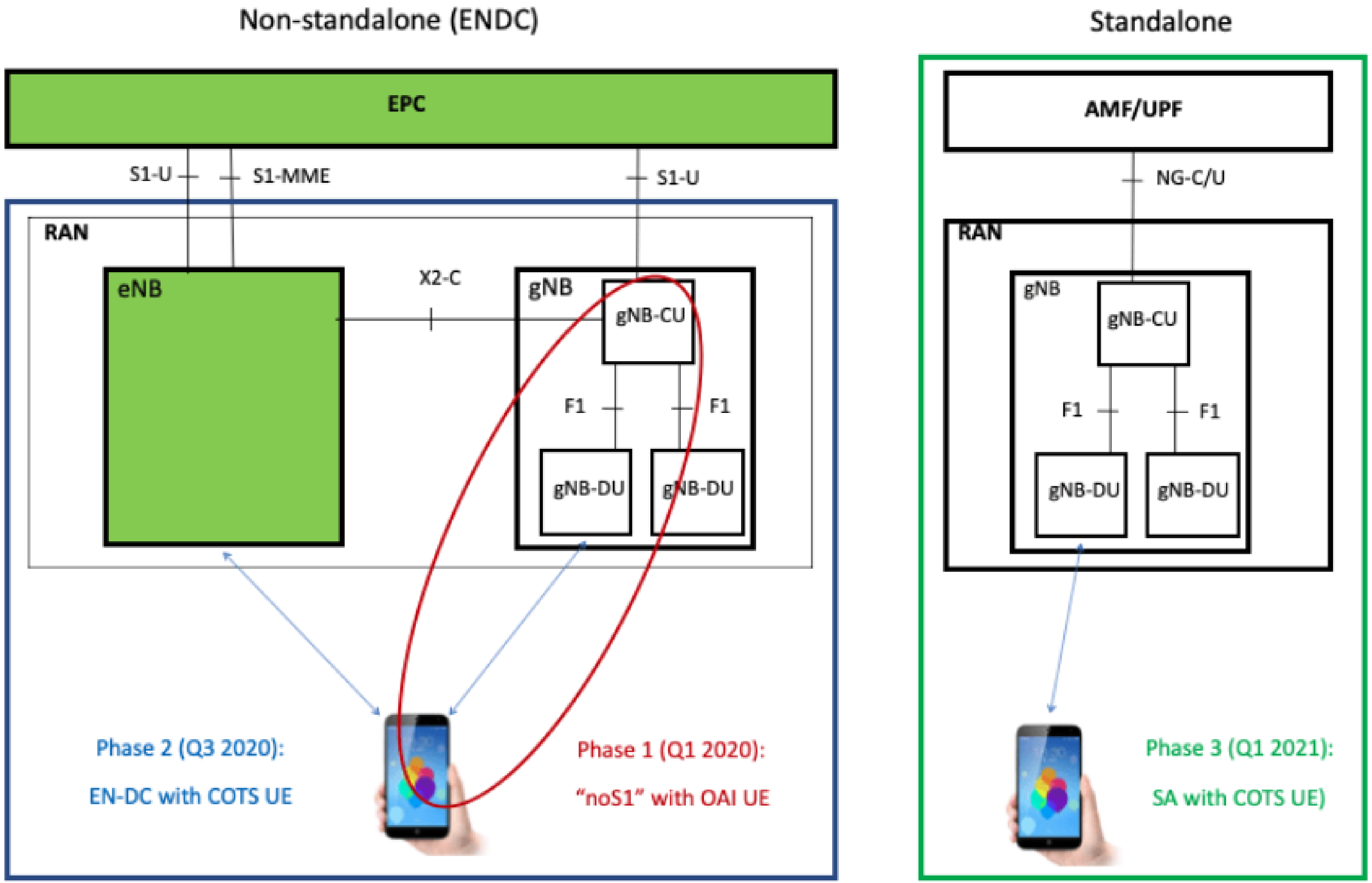
LAB ARCHITECTURE

The overall architecture is depicted below, with the main NW elements, such as IMS, EPC, 5GC, eNB, gNB and SDR. We are currently deploying the LTE NW.



4G / 5G OPERATION MODES

The OpenLab will allow the use of both 5G SA / NSA modes, with UE operating also in ENDC mode



HARDWARE DESIGN

- All radios at OpenLAB are SDR, meaning users have control over all related parameters. We are using a combination of USRPs from Ettus, Dell servers and desktops, antennas, attenuators, cables, etc.
- OpenLAb operates with a frequency range from 800 MHz up to 6 GHz, emulating a mobile NW deployment in both dense and rural areas.

The 4G LTE Network is implemented using:

- USRP x300 + daughterboard
- 4 antennas vert900 dualband, 824-960 Mhz and 1710-1990 Mhz
- accessories: cables, programmable attenuators, etc

The 5G LTE Network is implemented using:

- USRP N300
- 4 antennas vert2450, dualband, 2.4-2.5 and 4.9-5.9 Ghz
- cables 10 gigabit sfp + ethernet cable
- accessories: cables, programmable attenuators, etc

The USRPs are connected to a host using 10 Gbps Ethernet connections, so flexible signal processing can be done elsewhere in the network.

USRP ETTUS N300

The RF front end features the AD9371 RFIC transceiver from Analog Devices to provide 2X2 MIMO capability, up to 100 MHz of instantaneous bandwidth and an extended frequency range from 10 MHz to 6 GHz.

FEATURES:

- 2 RX, 2 TX
- Filter banks
- 10 MHz to 6 GHz
- Up to 100 MHz bandwidth per channel
- Baseband Processing
- Xilinx Zynq 7035
- Dual-core ARM Cortex-A9 800 MHz with 1 GB DDR3 RAM

Ettus Research™
A National Instruments Brand

USRP ETTUS X300

The Ettus Research USRP X300 is a high-performance, scalable software defined radio (SDR) platforms covering DC – 6 GHz with up to 120 MHz of baseband bandwidth, multiple high-speed interface options (PCIe, Dual 1/10 GigE)

FEATURES:

- Two wideband RF daughterboard slots
- Up 120MHz bandwidth per channel
- Selection covers DC to 6 GHz
- Large, customizable Kintex-7 FPGA
- Multiple high-speed interfaces
- Dual SFP(+) ports for 1/10 Gigabit Ethernet

OPENSOURCE SW COMPARISON

We conducted an extensive comparison among all main opensource SW available in the market:

- NextEPC: https://nextepc.org/
- OpenAirInterface: https://openairinterface.org/
- SRSLte: https://www.srslte.com/
- ORANSC: https://o-ran-sc.org/
- Open5GS: https://open5gs.org/

Considering the main features of these SW implementations, we made our comparison and chose the OAI:

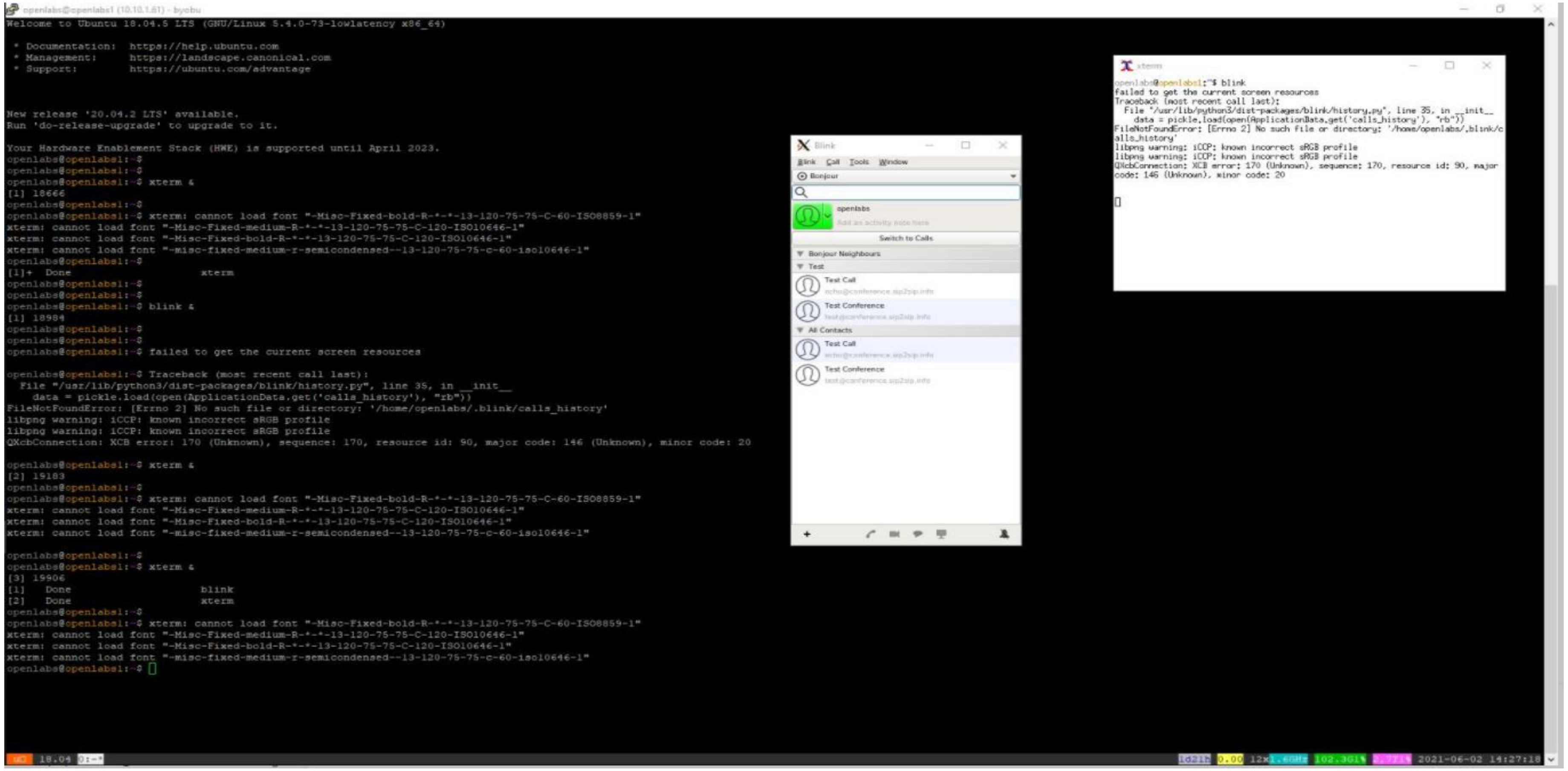
- Provided coverage
- Current implementation status and roadmap
- Community & support
- Installation complexity
- Available documentation
- Necessary equipment
- ORAN-Alliance compliance

SOFTWARE DESIGN

- After an extensive and thorough comparison between existing opensource SW solutions, we decided to use the OAI implementation.
- The OAI 4G stack supports the 4G EPC, eNB, etc.
- The OAI 5G stack will support 5GC, SA and NSA modes, gNB, UE, RAN Intelligent Controller (RIC), etc
- Some other necessary SW components used in our environment:
  - SIP Server: management of SIP calls, responsible for taking requests from the user agents, to place and terminate calls
  - MySQL + HSS: used to implement the subscriber database and their configuration
  - VPN server: used to create the testing environment allowing the non 3GPP access use cases
  - Monitoring application: wireshark

DEPLOYMENT STATUS

This is an ongoing project. Currently we are deploying the 4G NW, starting the comissioning tests and preparing to the virtualization and cloudification environments, showing the feasibility to run 4G (and possibly 5G NR) in real-time on a software defined radio platform



THANK YOU!