OpenRAN@Brasil Program

Rezende

Rede Nacional de Ensino e Pesquisa (RNP)

III Workshop de Testbeds (WTestbeds)

Agenda

- What is Open RAN?
- The OpenRAN@Brasil Program
- Next Steps
- Final Remarks

What is Open RAN?

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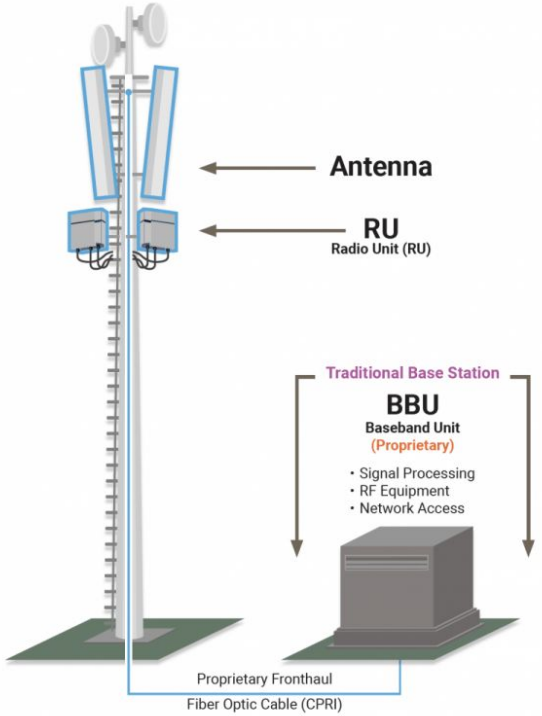
What is Open RAN?

- RAN (Radio Access Network)
  - Users' entry point to the network
  - In general, composed of three elements
    - Antenna
    - Radio Unit (RU)
    - Baseband Unit (BBU)



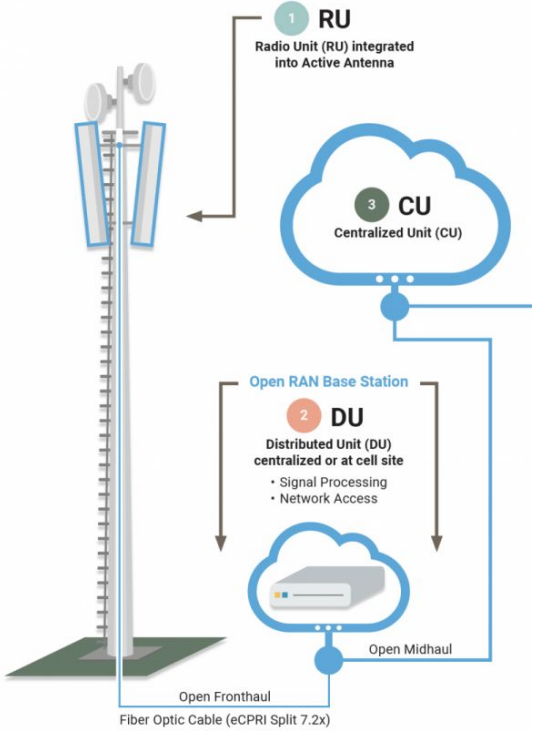
Source: https://www.mavenir.com/wp-content/uploads/2020/11/Open-RAN-Infographic-FINAL.pdf

What is Open RAN?

- Traditional Operator Networks
  - Proprietary hardware and software
  - Closed and proprietary interfaces
  - Single vendor
    - Creates a **lock-in** between the network operator and the vendor
    - Performance reduction when deploying cells from different vendors
    - Barrier for innovation

What is Open RAN?

- Three main elements
  - Radio Unit (RU)
  - Distributed Unit (DU)
  - Centralized Unit (CU)
- Programmable and software-defined operation
  - DU and CU may run as virtualized SW functions on off-the-shelf HW
- Open and standardized interfaces
  - Modular and Multivendor
- "Disaggregated RAN"
  - Network agility and flexibility
  - Increased innovation
  - Cost savings



Source: https://www.mavenir.com/wp-content/uploads/2020/11/Open-RAN-Infographic-FINAL.pdf

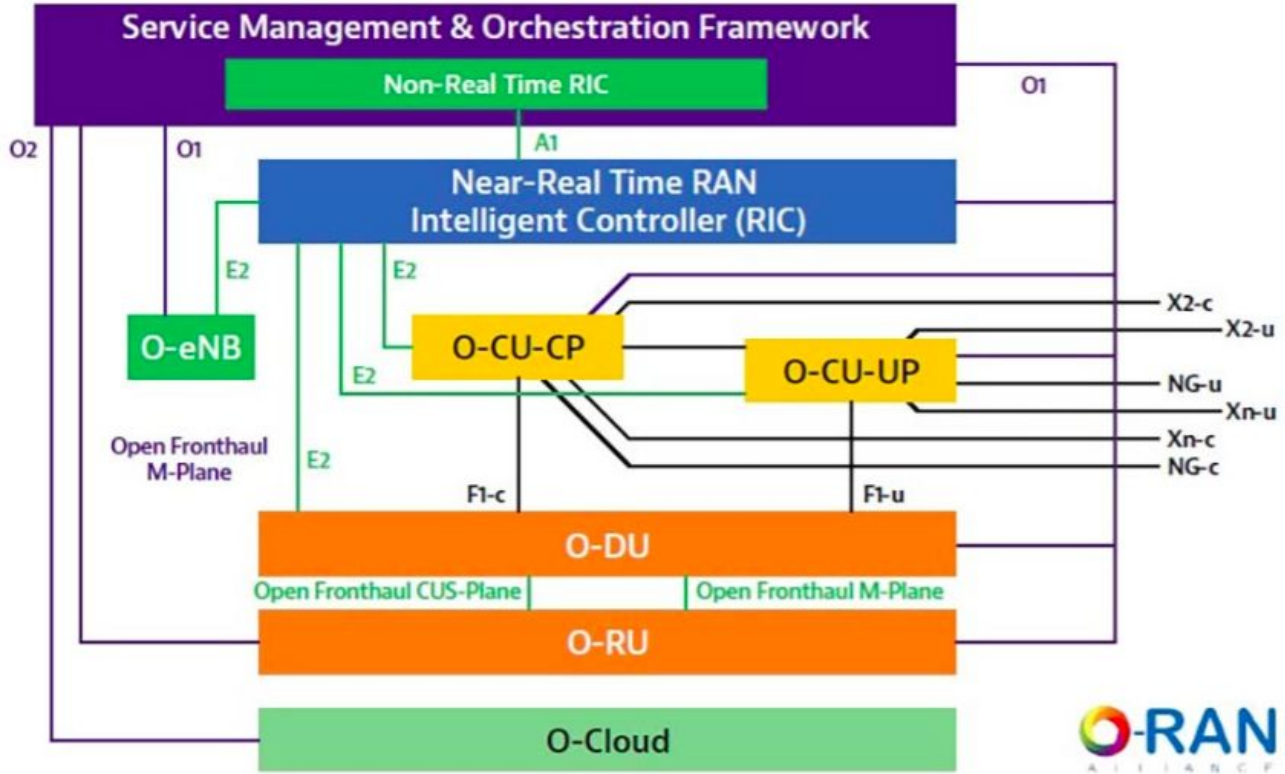
Open RAN Initiatives

- O-RAN Alliance
  - Founded by AT&T, China Mobile, Deutsche Telekom, NTT DOCOMO and Orange
  - Architecture for open, intelligent, virtualized and fully interoperable RAN
- Telecom Infra Project (TIP)
  - A Meta initiative
  - Non profit organization focused on advance global connectivity
- Open Network Foundation (ONF)
  - Proposed the Software-Defined RAN (SD-RAN)
    - 3GPP compliant and consistent with the O-RAN architecture

Open RAN Suites

- Radisys
  - commercial suite, disaggregated and containerized software for RAN and CN
- Open Air Interface (OAI)
  - open software for RAN and CN technologies developed by a community of developers from around the world
- SRSRAN Project
  - open-source 4G and 5G software radio suites developed by Software Radio Systems

O-RAN Architecture



The OpenRAN@Brasil Program

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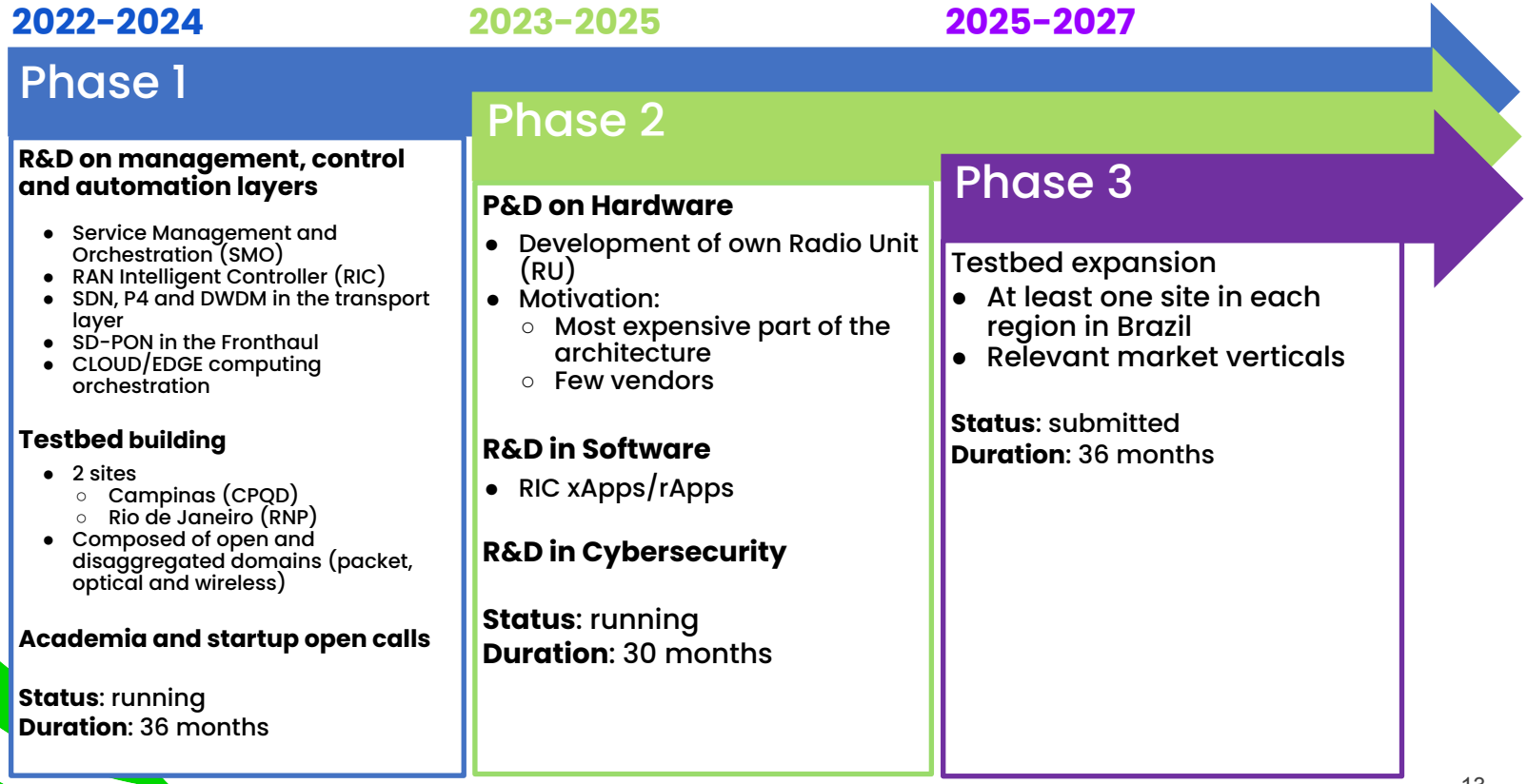
The OpenRAN@Brasil Program

- **Aspiration:** to accelerate the development of an open network ecosystem from research, development, innovation and workforce training in technologies and applications related to 5G and beyond
  - Stimulating interaction between actors from industry, academia and government
  - Promoting different application scenarios
  - Promoting collaborative development models (mainly open source)
  - Promoting the innovation ecosystem through the experimentation and demonstration space
  - Promoting workforce training

The OpenRAN@Brasil Program

- Cornerstones
  - **Research, develop, deploy and validate** innovative solutions for intelligent management and control of open and disaggregated networks in different technological domains
  - **Build and make available** experimentation infrastructures in different technological domains that adopt openness and disaggregation
  - **Train** professionals and **engage** academia/industry

OpenRAN@Brasil - Phases



OpenRAN@Brasil - Partners

Execution	
Phase 1	**Phase 2**
RNP ORGANIZAÇÃO SOCIAL DO MCTI · cpqd	RNP ORGANIZAÇÃO SOCIAL DO MCTI · cpqd · ELDORADO · Inatel
UNICAMP · UNIVERSIDADE FEDERAL DO PARÁ · uff	UNIVERSIDADE FEDERAL DO PARÁ · UFG · UNISINOS · UFCG
Coordination	
RNP ORGANIZAÇÃO SOCIAL DO MCTI	

The OpenRAN@Brasil Phase 1

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Phase 1

- Objective:
  - R&D to build an open and programmable infrastructure (testbed)
    - Disaggregated equipments
    - Offered to different communities (academia, industry and service providers)
  - Foster RD&I in open RAN
    - Working groups & Startups
  - Train specialized workforce in different open RAN technologies

Phase 1 - Testbed

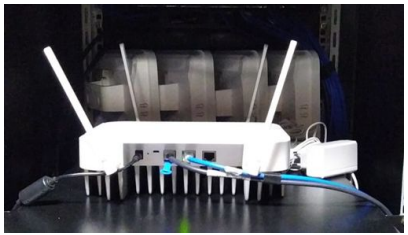
- Testbed characteristics
  - Open hardware
  - Open software
    - Developed by international communities/initiatives
  - Paradigms
    - Softwarization, Virtualization and Disaggregation

- Testbed resources
  - multiple technological domains
    - Edge/central cloud, packet (P4), optical (PON and DWDM networks) and wireless (Open RAN 5G)
  - multiple RICs
    - SD-RAN (ONF) and O-SC (O-RAN Alliance)

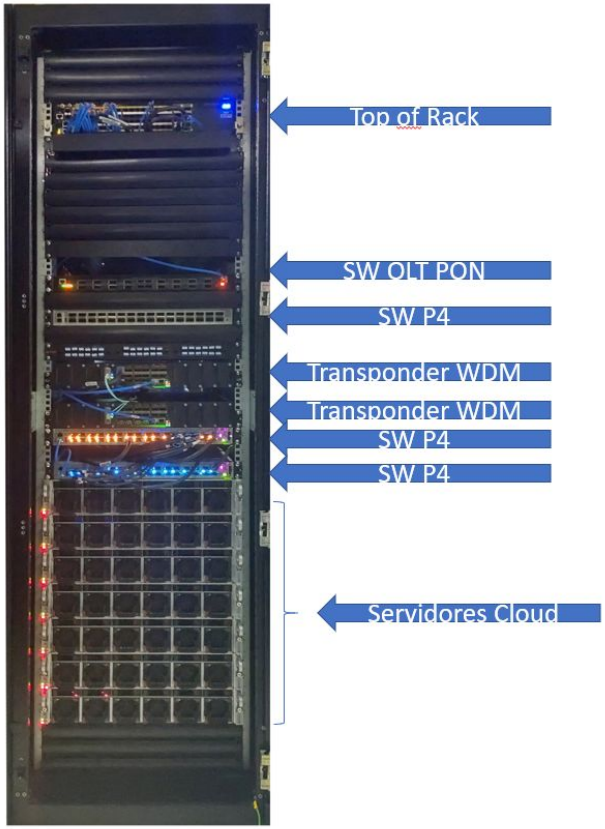
Phase 1 - Testbed

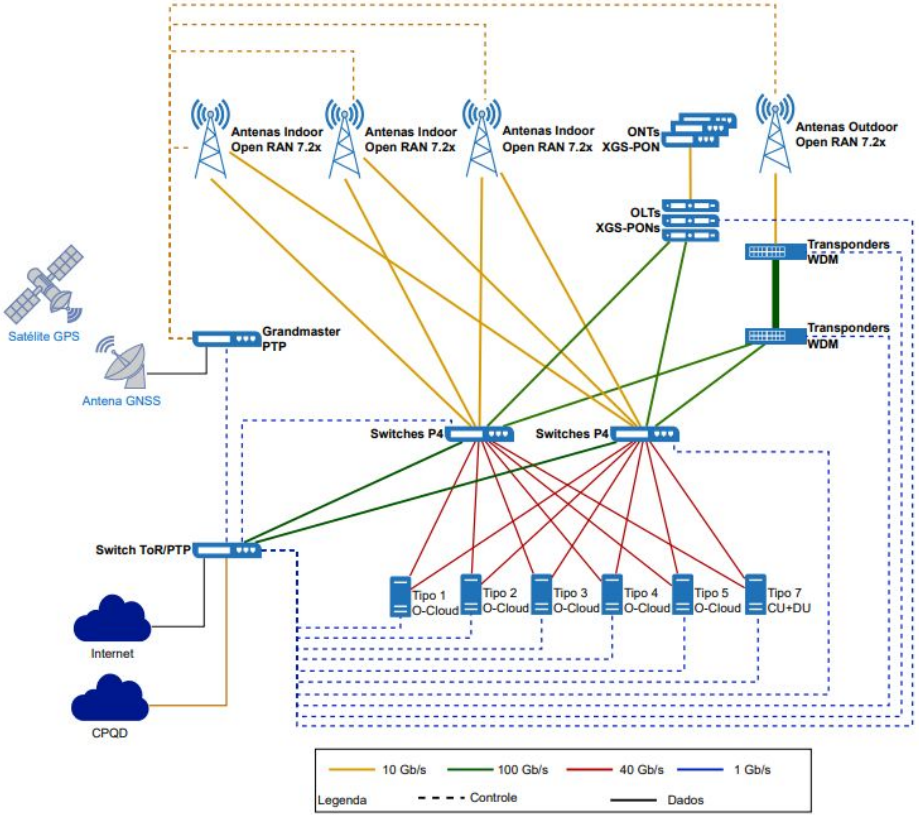
- O-RAN Alliance Split 7.2X architecture
  - O-RU disaggregated from O-DU
- Computing
  - 7 servers

- O-RAN antennas
  - 3 indoor and 1 outdoor (in acquisition) 5G O-RAN antennas
- Packet domain
  - Leaf-spine topology
  - P4 switches
- Optical domain
  - PON (XGS-PON and GPON)
  - DWDM



Site PoP-RJ


Top of Rack
SW OLT PON
SW P4
Transponder WDM
Transponder WDM
SW P4
SW P4
Servidores Cloud


Antenas Indoor Open RAN 7.2x
Antenas Indoor Open RAN 7.2x
Antenas Indoor Open RAN 7.2x
ONTs XGS-PON
Antenas Outdoor Open RAN 7.2x
OLTs XGS-PONs
Transponders WDM
Transponders WDM
Satélite GPS
Antena GNSS
Grandmaster PTP
Switches P4
Switches P4
Switch ToR/PTP
Tipo 1 O-Cloud
Tipo 2 O-Cloud
Tipo 3 O-Cloud
Tipo 4 O-Cloud
Tipo 5 O-Cloud
Tipo 7 CU+DU
Internet
CPQD
10 Gb/s
100 Gb/s
40 Gb/s
1 Gb/s
Legenda
Controle
Dados

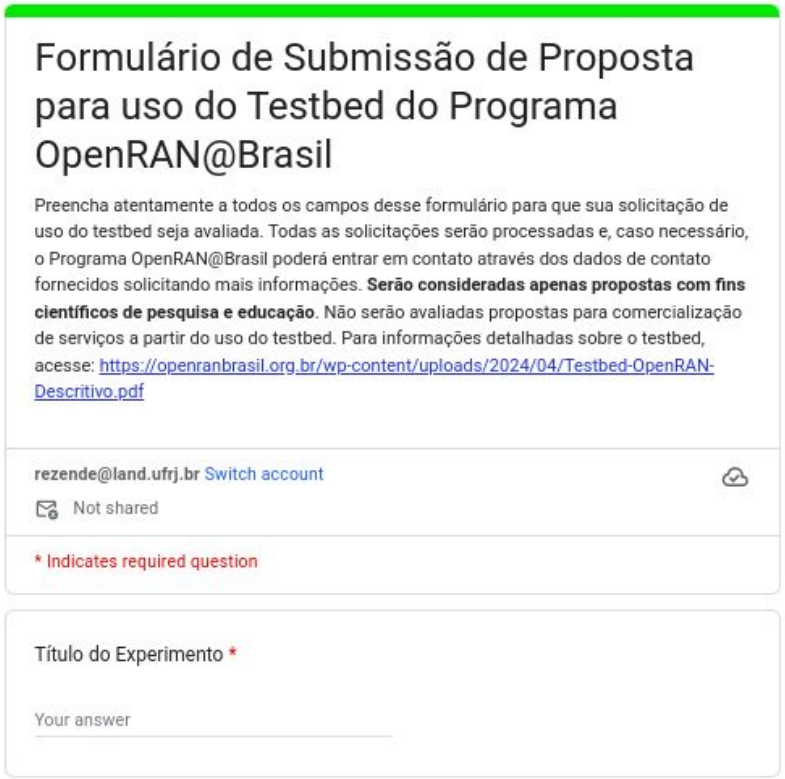
Phase 1 - Testbed

- Sites
  - Two sites deployed in Phase 1
    - CPQD - Campinas, SP
    - RNP - Rio de Janeiro, RJ
  - Both located in the southeast
    - Geographical distance: 397 km (~246.7 miles)
    - Road distance: 493.1 km (~306.4 miles)
  - Connected by a 10 Gbps link

Open Calls

WGs & Startups	Topic
ORAN-QOS	QoS for open RAN
Plateou	Slicing orchestration
OIRAN	High availability, low power orchestration
FAIR-5G	5G security
AGIR	Intent-based management for open RAN
IQoS	Smart Management for QoS
Acta Robotic	Robotics
Anlix	Monitoring
Cromai	Agriculture
Pix Force	Industry 4.0
Quickium	Computer vision
Ring-0 Networks	Security

Uso do testbed



Formulário de Submissão de Proposta para uso do Testbed do Programa OpenRAN@Brasil

Preencha atentamente a todos os campos desse formulário para que sua solicitação de uso do testbed seja avaliada. Todas as solicitações serão processadas e, caso necessário, o Programa OpenRAN@Brasil poderá entrar em contato através dos dados de contato fornecidos solicitando mais informações. **Serão consideradas apenas propostas com fins científicos de pesquisa e educação**. Não serão avaliadas propostas para comercialização de serviços a partir do uso do testbed. Para informações detalhadas sobre o testbed, acesse: https://openranbrasil.org.br/wp-content/uploads/2024/04/Testbed-OpenRAN-Descritivo.pdf

rezende@land.ufrj.br Switch account

Not shared

* Indicates required question

Título do Experimento *

Your answer

Acesso ao Testbed

The OpenRAN@Brasil Phase 2

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Phase 2

- Objectives:
  - R&D of a 5G O-RAN Alliance compliant Radio Unit (O-RU)
  - R&D of smart SDN applications for the Open RAN domain (xApps/rApps)
  - Open RAN cybersecurity risk analysis

- Hardware
  - 8T8R (40W each)
  - N78 Band
- O-RU management software
  - NETCONF protocol/YANG models

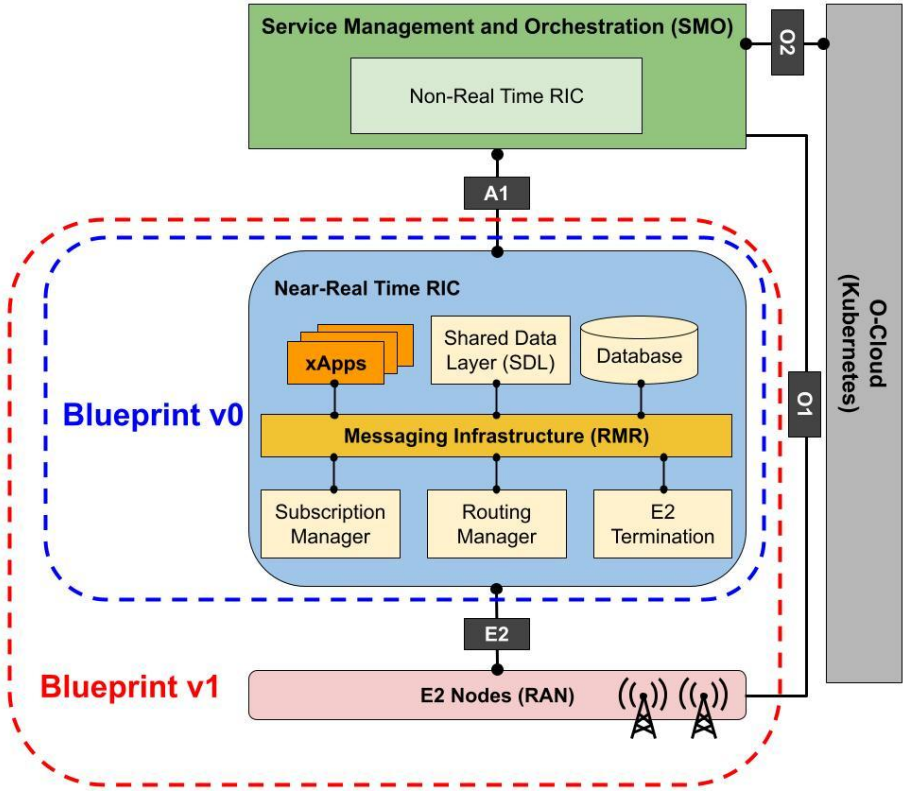
xApps and rApps

- What are they?
  - Automation and optimization tools
  - Control and management features
- Differences
  - xApp: near-real time
    - Optimize radio spectrum efficiency
  - rApp: non-real time
    - ML for establishing policies

- Four xApps in development
  - RIC distribution
  - Energy consumption
  - Network slicing
  - Self-organizing RAN
- Two different RICs being explored
  - Open Network Foundation: SD-RAN
  - O-RAN Alliance: SC

xApp/rApp Development Environment

- blueprints w/ O-RAN SC (OSC)
  - pre-built VM images with all application development environment
  - v0: near-RT-RIC release I with “Hello World xApp”
  - v1: v0 + e2sim + xApp that interacts with the radio
  - v2: v1 + ns-3 (to be released in Oct/24)



The OpenRAN@Brasil Phase 3

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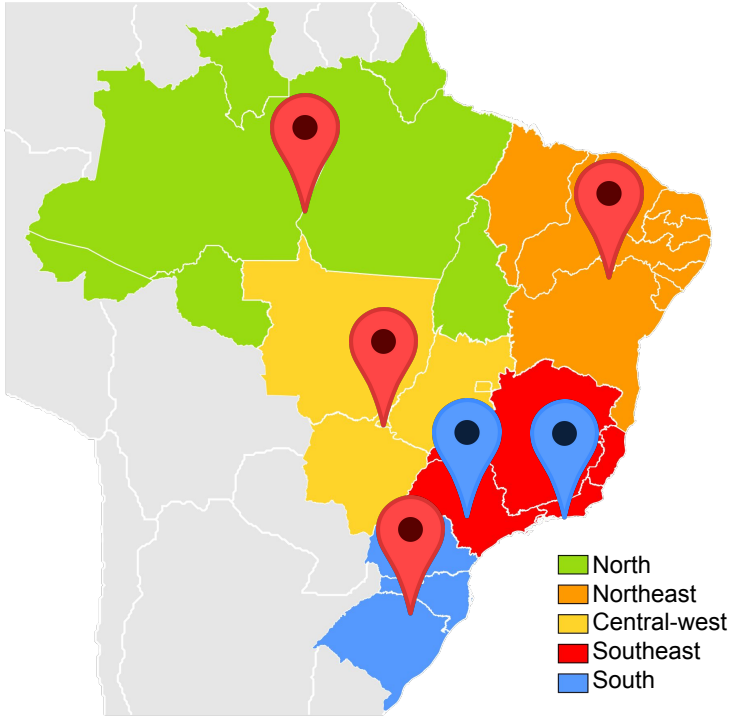
Phase 3

- Objectives:
  - Expand the testbed infrastructure to every region in Brazil
    - North, Northeast, Central-west, South
  - R&D on applications
    - Industry
    - Agriculture
    - Health
    - Education
    - Cities
    - Gaming



Next steps

- Testbed release
  - October 2023
  - Incremental release
    - v1.0: 5G open RAN network capabilities
    - v2.0: Smart orchestration capabilities
    - v3.0: New capabilities
      - addition of GPUs for ML/AI
      - Improved Wi-Fi capabilities
      - new OpenRAN suites
- Incorporate additional partners
  - New ICTs want to be part of the program
  - Build a community of open RAN research in Brazil
  - Put together different infrastructures
    - commercial and open source Open RAN stacks
  - Test interoperability
  - Knowledge exchange

Final Remarks

- Open RAN stimulates competition in the communication industry
  - Open the market for new hardware/software vendors
  - Cost reduction for operators
    - Single vendor dependency reduction
  - Interoperability between different components allows the adoption of more suitable solutions for specific scenarios

Final Remarks

- Open RAN can boost advances in innovative applications
  - Flexibility and interoperability facilitate the appearance of new services and business models
    - New apps/services for advanced scenarios (smart cities, industrial automation, digital health, …)
  - Driving digital transformation in different sectors
    - Health, agriculture, education, among others…

Final Remarks

- The OpenRAN@Brasil Program has the potential of
  - Fostering innovation
  - Strengthening national industry
  - Expanding connectivity
  - Promoting global collaboration

Thanks!

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