Connecting ideas, anticipating the future:
collaborative innovation for 5G and 6G networks.

II INTERNATIONAL WORKSHOP
xGMobile

Organized by:

xGMobile Centro de Competência EMBRAPII Inatel em Redes 5G e 6G

Inatel

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GOVERNO DE MINAS
AQUI O TREM PROSPERA.

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÃO

GOVERNO DO BRASIL
DO LADO DO POVO BRASILEIRO

Open RAN at the Intersection of Telecom, Cloud, and AI: Enabling Next-Gen Connectivity in Brazil

Fuad Abinader (fuad@cpqd.com.br)

EMBRAPII CPQD Excellence Centre in Open Networks (EXCCON)

Organized by:

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CPQD in a Nutshell

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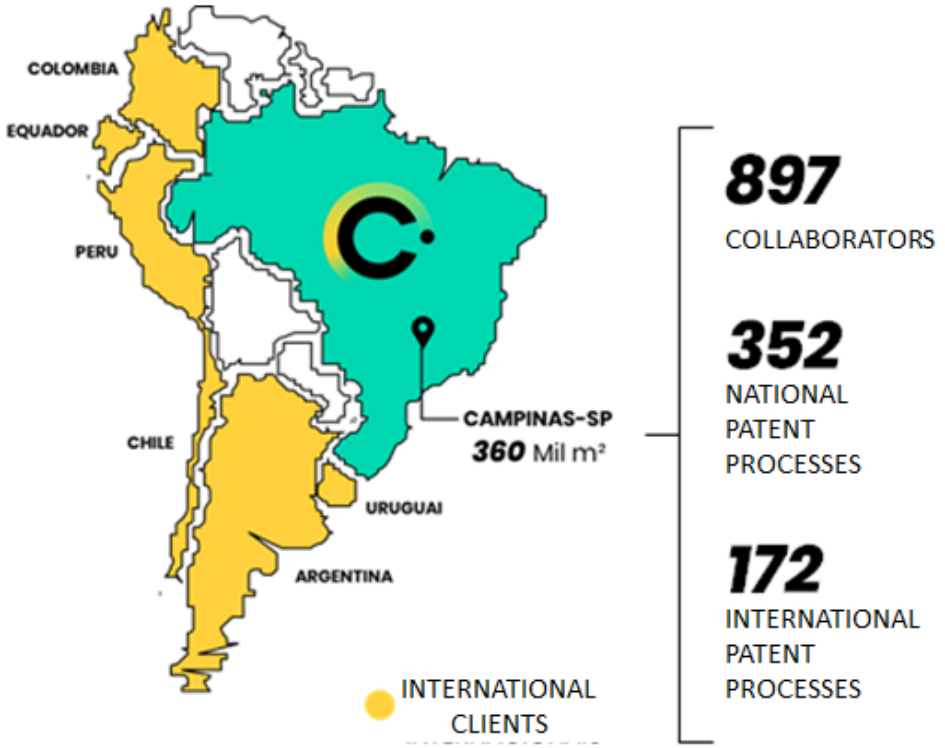
MCTI EMBRAPII cpqd



897
COLLABORATORS

352
NATIONAL PATENT PROCESSES

172
INTERNATIONAL PATENT PROCESSES

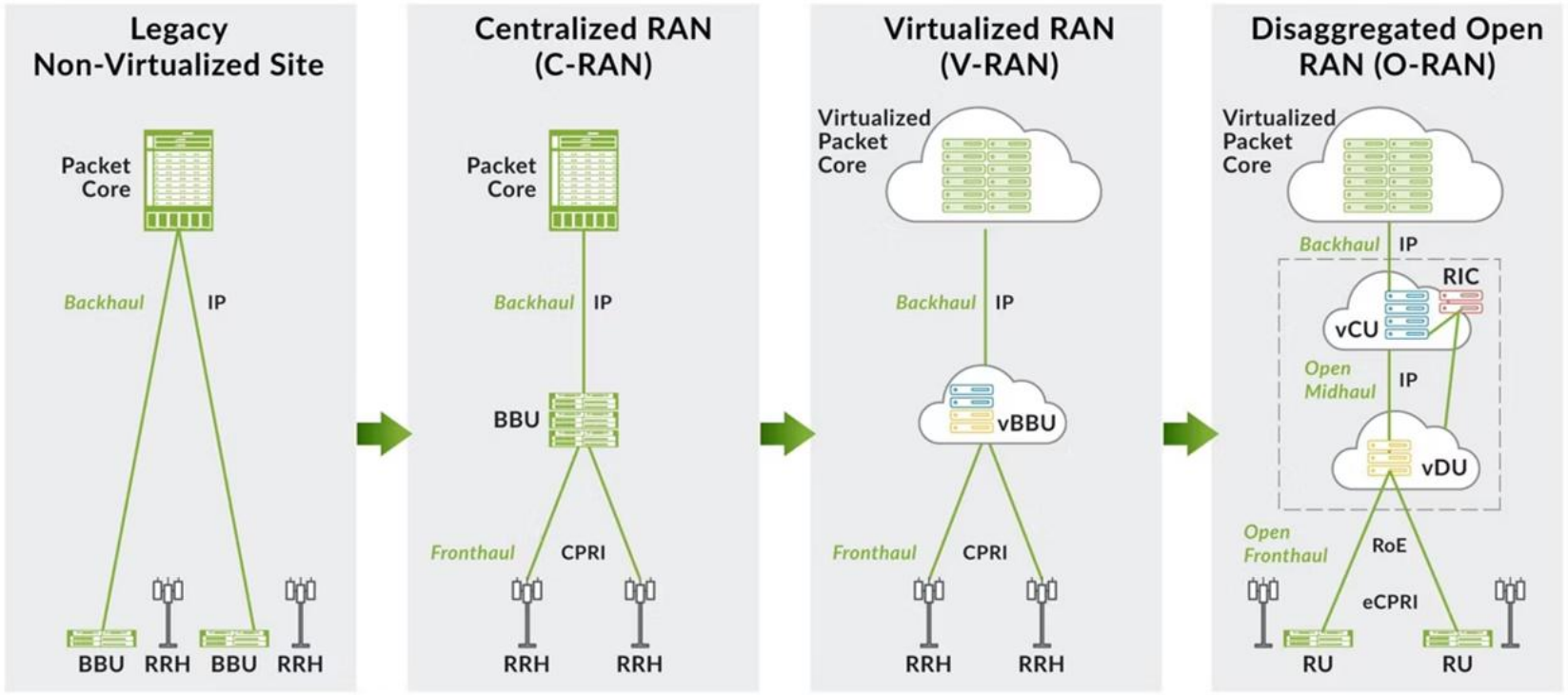
2 SPIN-OFFS

TRÓPICO (WIRELESS AND DATA NETWORKS)
PADTEC (OPTICAL COMMUNICATIONS)

- **Founded in 1976** as the R&D branch of Telebrás (public national telecom operator)
- After the **privatization process in 1998** it became a **private not-for-profit foundation**
- Largest ICT R&D Program in Latin America
- Revenues of R$ 229 mi (~ €37 mi) in 2019
- Presence in all telecom operators in Brazil and some in Latin America (OSS Suite)
- Certified labs for compliance testing according to local regulations
- Host of a TIP Community Lab
- Brazilian branch of the BRICS Institute for Future Networks Initiative
- Deep knowledge of the local regulatory framework and market structure

The Open RAN Paradigm & Motivations

Evolution of RAN Architecture: Traditional vs. Open RAN (O-RAN)



RRH = Remote Radio Head
BBU = Baseband Unit
CPRI = Common Private Radio Interface

RIC = RAN Intelligent Controller
CU = Centralized Unit
DU = Distributed Unit

RU = Remote Unit
RoE = Radio over Ethernet
eCPRI = Ethernet CPRI

Source: Juniper Networks

Rapid growth in NW capacity demand and diverse services.

O-RAN → disaggregated components connected via open interface, powered by NFV and SDN advances.

Provides reduced TCO, flexibility and rapid innovation cycles.

Challenges include *latency requirements* and ensuring *sufficient processing capacities* for NFVs.

Moving Towards a Brazilian Open RAN

Challenges for the Open RAN ecosystem in Brazil

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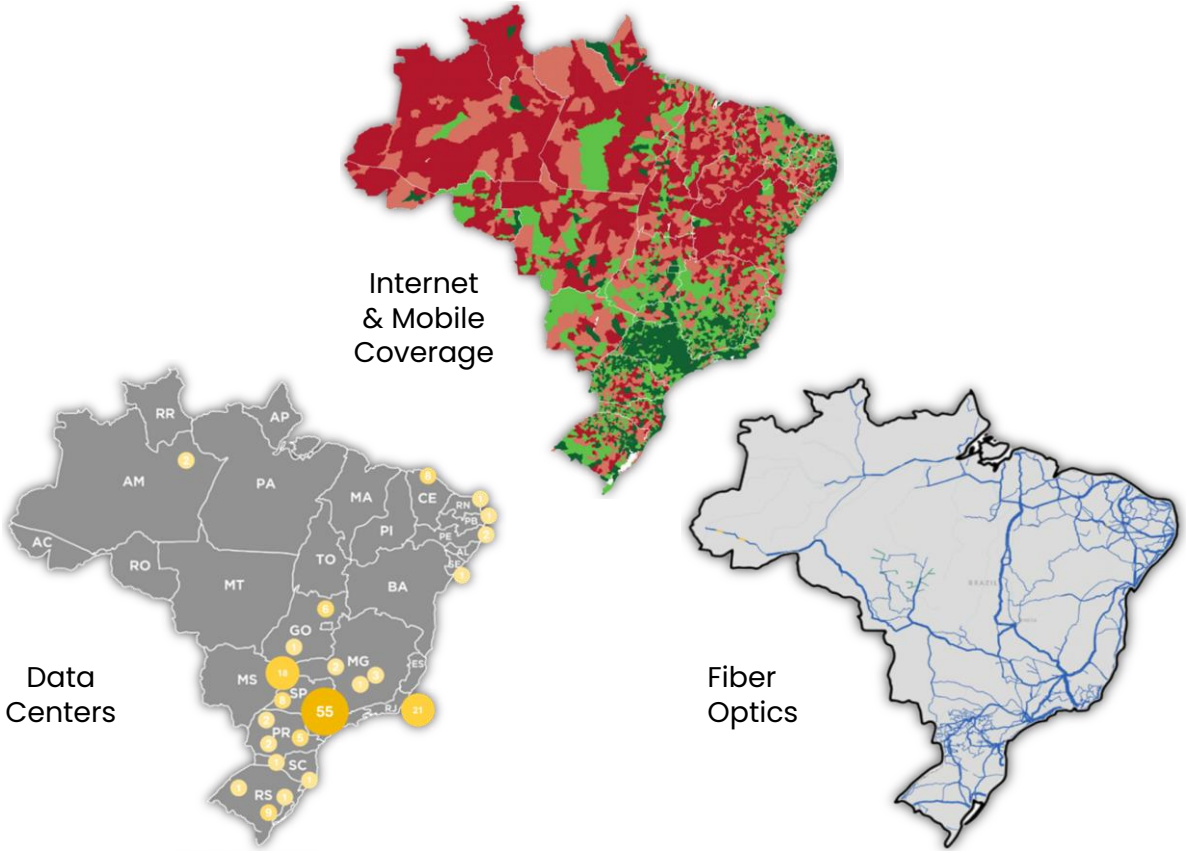
O-RAN Alliance is majorly influenced by North Hemisphere countries

Region	Operators	Members
North America	7	~50–70
Latin America	0	~5–10
EMEA	8	~80–100
Japan / North Korea	7	~40–60
APAC	4	~30–40
Greater China	4	~40–60
Total	30	300+

Continental Dimensions, Isolated Areas, Heterogeneous Infrastructure, and the Challenges for 5G Monetization for 5G Broad Expansion



Open RAN @ CPQD

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A platform to research, develop and test new technologies and use cases considering **State-of-the-art** technologies (Open RAN, SDN, 5G, etc), a **Learning** environment for universities to execute tests, a **Lab** used for new technologies validations and a Space to **promote** the development of Open RAN solutions through 5G applications

openRAN BRASIL

Plataforma 5G BR

Development of **end-to-end 5G network** technologies, targeting private network markets, and small and medium providers. Development of 5G core and RAN through **virtualization and disaggregation.** Integration with an RU (Radio Unit) compatible with open architectures (TIP, O-RAN Alliance). Development of the **services and infrastructure automation** platform to manage the creation, control and monitoring of network slices in 5G networks.

EMBRAPII CPQD Excellence Centre in Open RAN (EXCCON)

Consolidating the Open RAN ecosystem in Brazil

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EXCELLENCE CENTRE IN
OPEN RAN
MCTI EMBRAPII cpqd

The accreditation of **CPQD** as the **Excellence Centre in Open Networks (EXCCON)**[1] stems from the initiative of the **Ministry of Science, Technology & Innovation** (MCTI) and the **Brazilian Company of Research & Industrial Innovation** (EMBRAPII).

US$ 25 M from EMBRAPII and FAPESP (50% each) during 42-month to operate 5 lines of action:

- **RD&I Projects**
- **HR Training** and **Education**
- Attraction, Creation and Acceleration of **Startups**
- Developing the Open RAN ecosystem wit the **Technological Association**
- **South American OTIC** (SAOC)

1 - https://www.cpqd.com.br/openran/

EMBRAPII CPQD Excellence Centre in Open RAN (EXCCON)

Connecting global standards to Brazilian needs

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Our Focus

Network Intelligence with AI/ML

Cloud Multi-X RAN Orchestration (Cloud/Tenant/ Vendor)

Energy Efficiency and specialized RAN HW

Digital Inclusing and Support for Verticals (Telemedicine, Agro 4.0 and more)

EMBRAPII CPQD Excellence Centre in Open RAN (EXCCON)

Mission, Vision and Competences

Mission: To drive Brazil's technological sovereignty in connectivity through high-quality, interoperable innovations in Open RAN, Cloud, and AI/ML for the RAN that address social and economic challenges

Vision: To be the catalyst for Brazil's regional leadership in open, virtualized and disaggregated 5G and 6G, building a fully intelligent and energy-efficient ecosystem where connectivity is a reality for all citizens

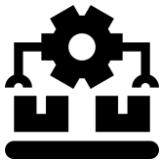
Competences:

Cert/IOT/E2E Certification

Testing & Prototyping

RAN SW Virtualization

Multi-X RAN Orchestration



Multi-X RAN Automation

RAN Network Intelligence

RAN Digital Twins

Energy Efficiency

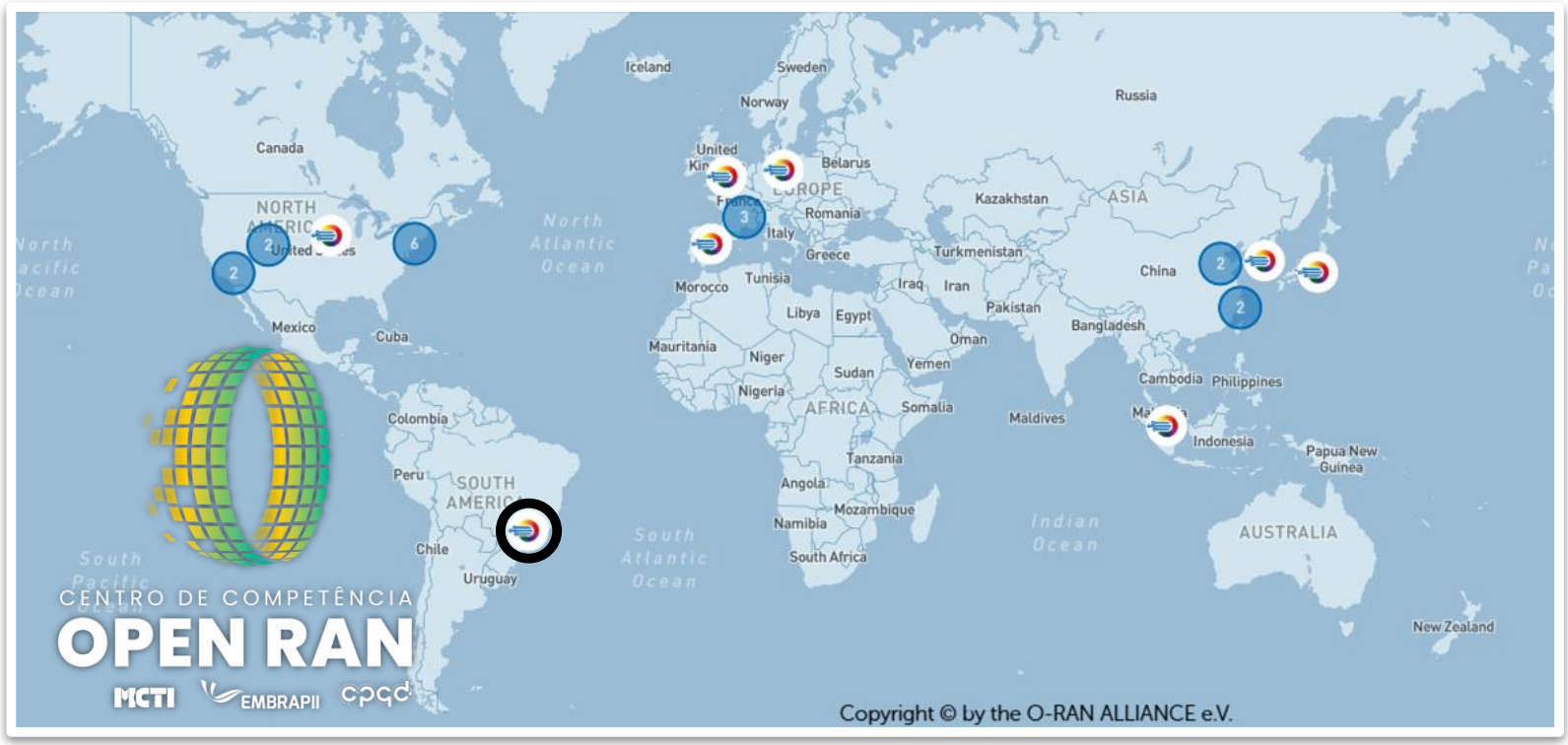
Support BR Ecosystem

EMBRAPII CPQD Excellence Centre in Open RAN (EXCCON)

SAOC, the LatAm Gateway for a Global Open RAN

South American OTIC ad Campinas (SAOC)

First *Open Test and Integration Center* (OTIC) of Latin America (LATAM)



Conformance, IOT and E2E Performance, Badging, PlugFests, and much more

Optimizing Open RAN for the Brazilian and LATAM ecosystems

Strategic MoUs

VIRGINIA TECH

Japan TIC

Wireless Comms @ *Pólis de Tecnologia*

360.000 m2, including NW and energy systems installed at rooftops of over 20 buildings, as well as a 40m cell tower

Open RAN R&D Program @ EXCCON

Towards An Open, Disaggregated, Virtualized and Intelligent 6G Future

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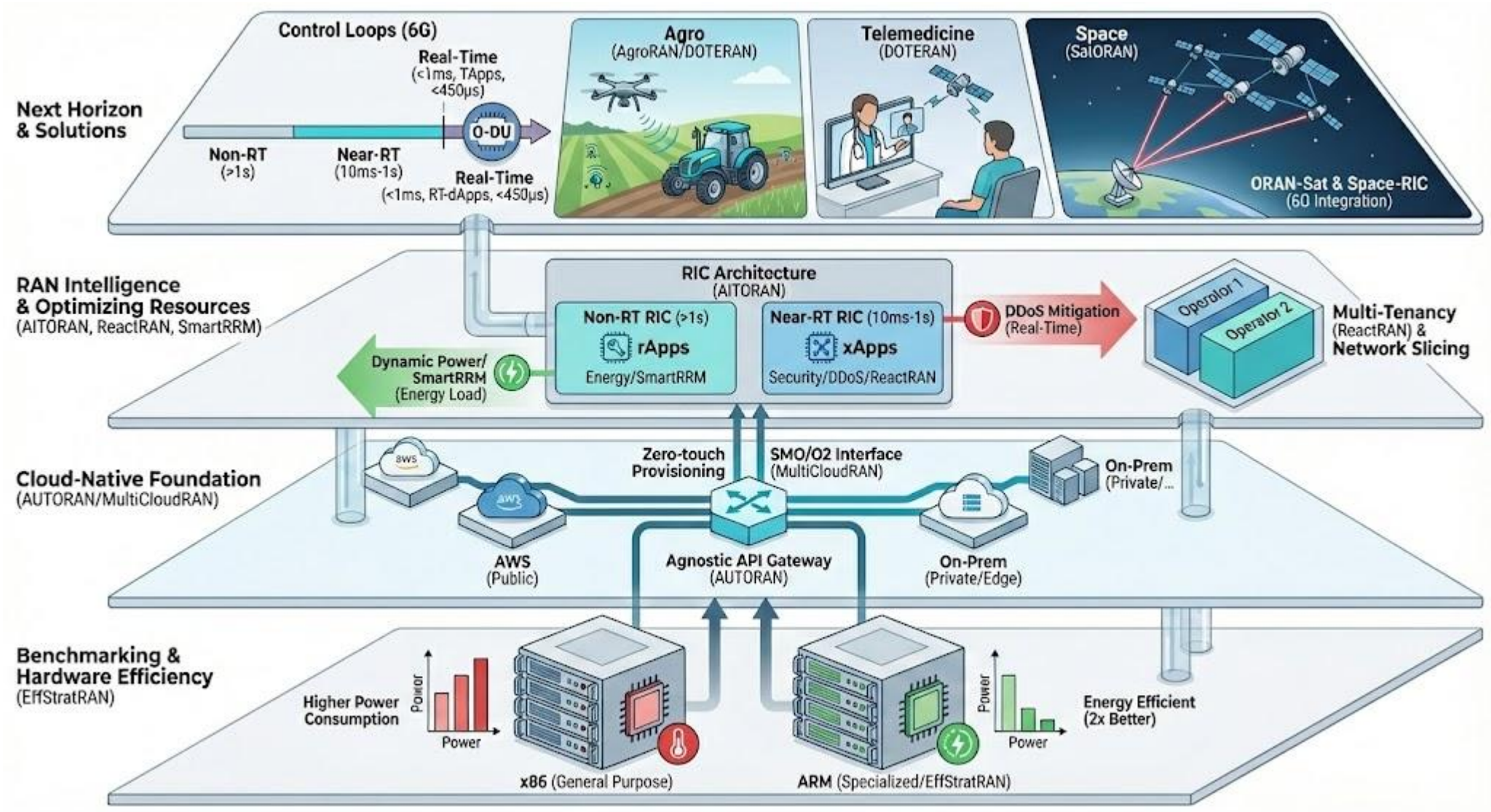


The Cloud-Native Foundation

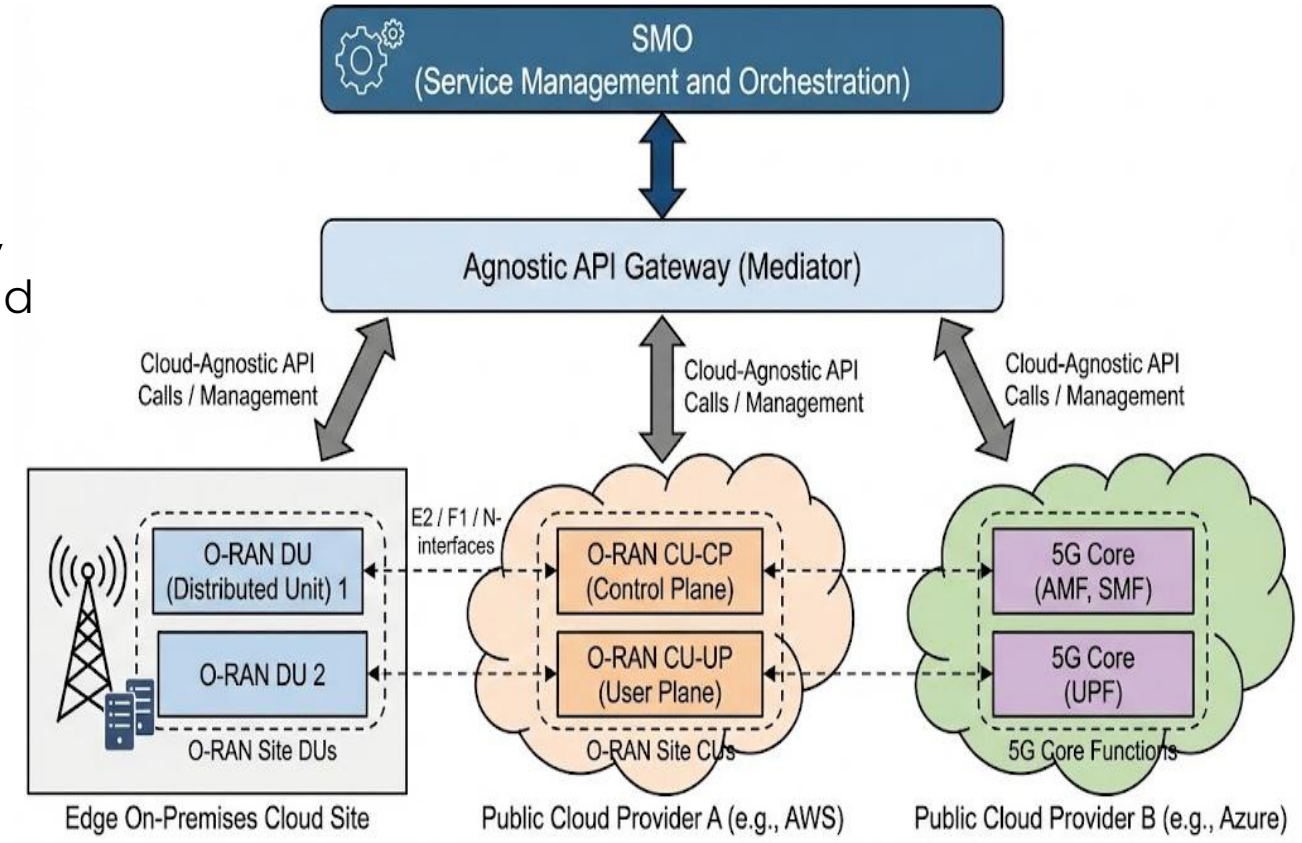
- AUTORAN and MultiCloudRAN projects

Challenge: Managing disaggregated networks across heterogeneous clouds (private, public, edge) is a complex and expensive tasks

Project AURORAN: Focused on automation strategies. Developed an **Agnostic API Gateway** to "translate" operations between different cloud providers, eliminating vendor lock-in.

Project MultiCloudRAN: Focuses on the O2 interface. Enables agnostic orchestration of heterogeneous resources.

Goal: Zero-Touch for provisioning Open RAN networks, where the network automatically deploys functions to the best available cloud resource.



RAN Intelligence (Security & Efficiency)

AITORAN Project

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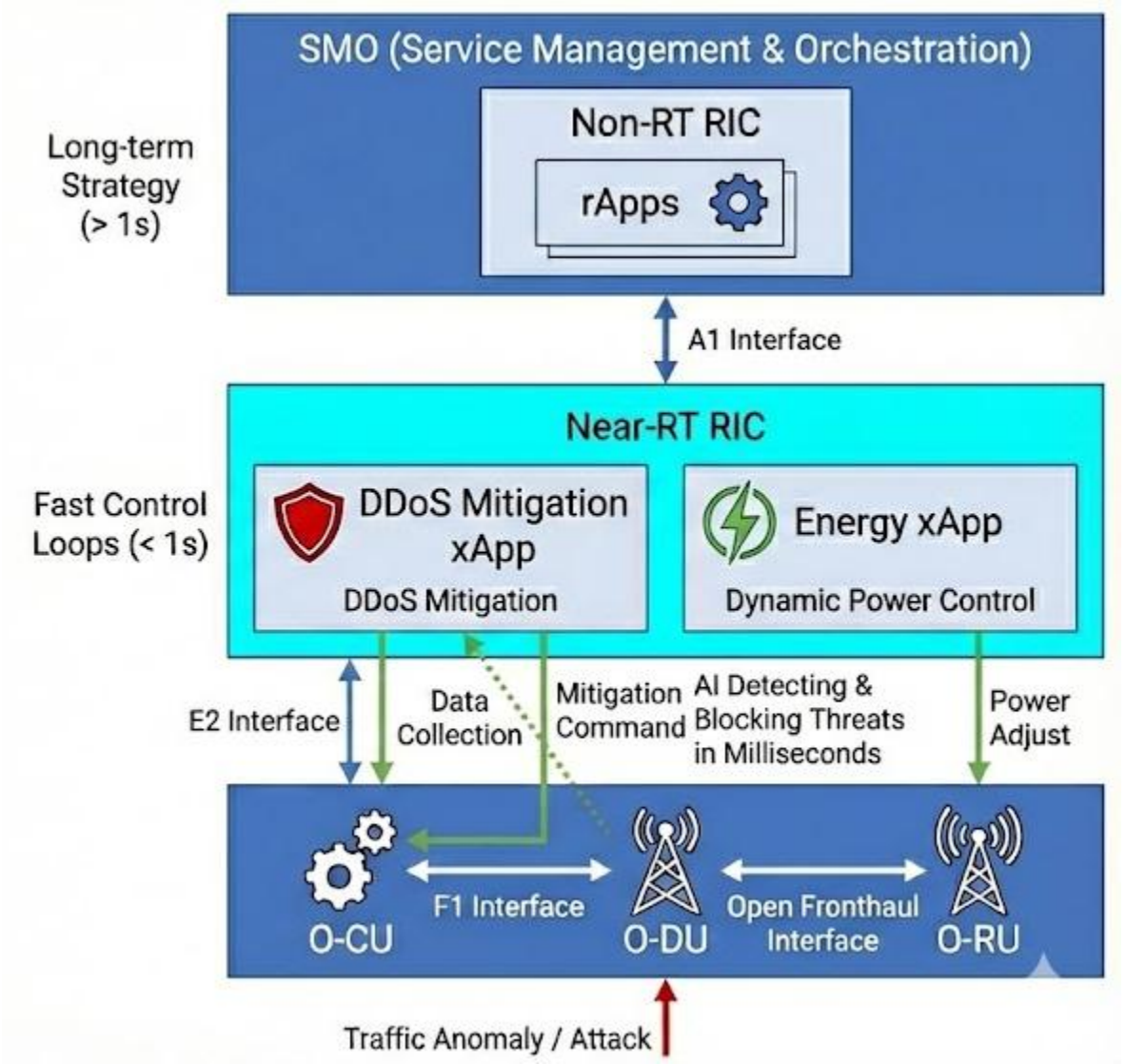
Challenge: Moving from static configuration to dynamic AI control via RIC

The AITORAN project provided a framework for AI/ML in the RAN

- **Security:** using xApps with AI/ML models for real-time DDoS mitigation on the initial access (signaling storm)
- **Energy Efficiency:** Dynamic DL power adjustments for Radio Units (RUs) based on traffic load, crucial for reduced CAPEX

Goal: Transform the network from reactive to proactive



Optimizing Resources (Multi-Tenant & Energy-Efficiency)

SmartRAN and ReactRAN projects

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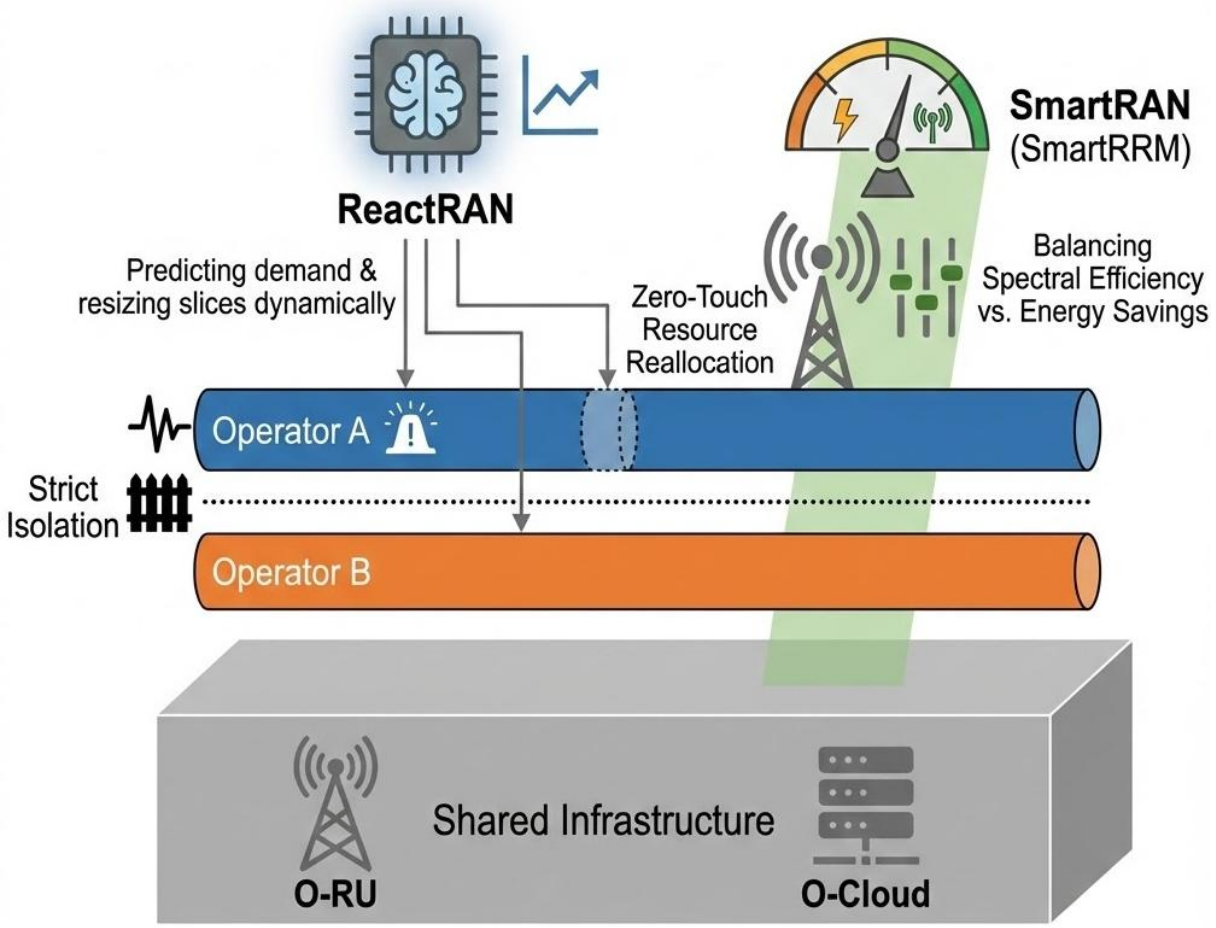
Challenge: Sharing infrastructure (i.e. neutral host models) is key for TCO reduction in Brazil.

Project ReactRAN: Focuses on Multi-Tenant environments. Ensures one tenant's traffic spike doesn't degrade another's service. Uses AI to predict demand and reconfigure RAN parameters dynamically.

Project SmartRAN: Extends multi-scale control (coordination between xApps and rApps). Optimizes Radio Resource Management (RRM) to balance spectral efficiency with energy consumption.

Goal: Transform the network from reactive to proactive



The Next Horizon: Ultra-Real-Time Control (6G)

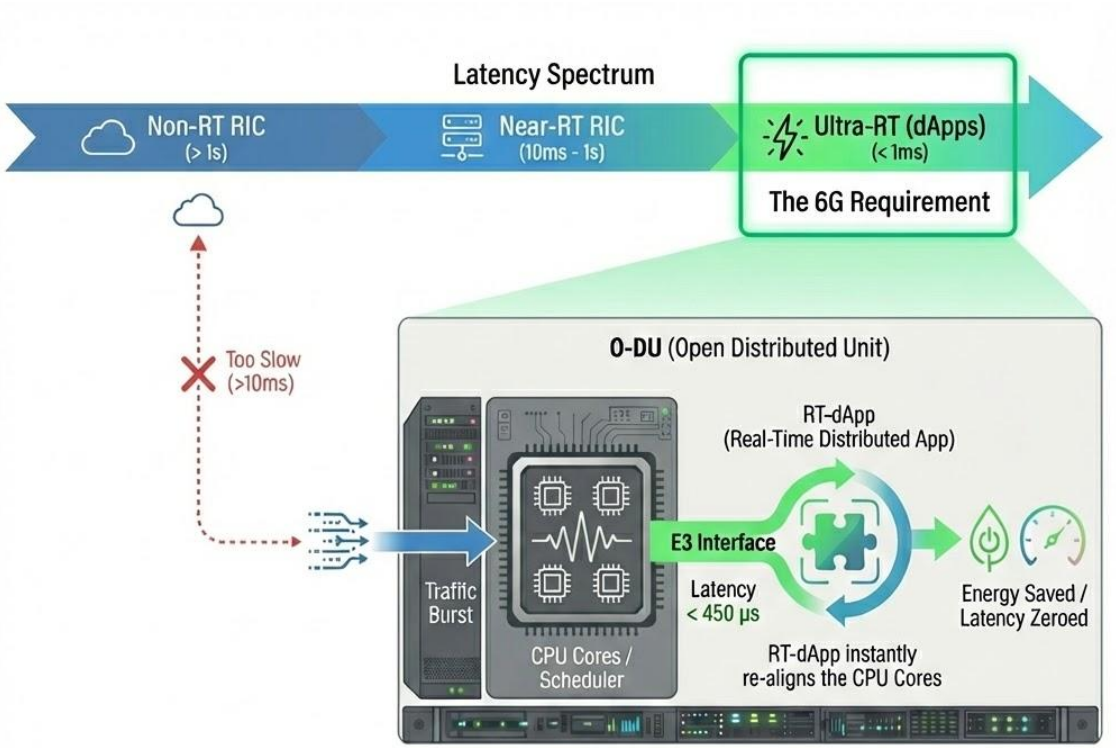
RT-dApps Project

Challenge: Current RAN architectures (RICs) have a "blind spot" for ultra real-time control loops (<10ms)

Project Real-Time dApps (RT-dApps)

- Brings AI control inside the O-DU.
- Uses the E3 interface for sub-ms optimizations.
- Initial use case is joint BWP adaptation with CPU Affinity optimization

Goal: Achieve sub-ms latencies for control actions, essential for future 6G applications.



Benchmarking & Hardware Efficiency

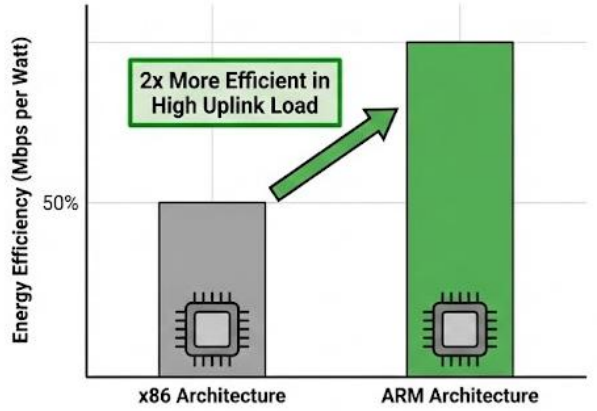
EffStratRAN Project

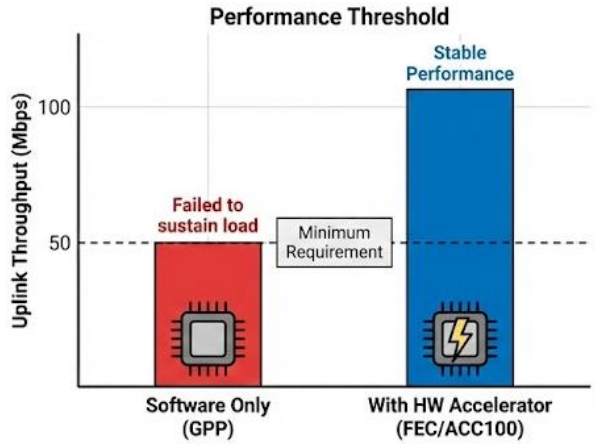
Challenge: The Hardware Dilemma: General Purpose Processors (x86) vs. specialized silicon (ARM, ASIC).

Project EffStratRAN

- Benchmarking energy-efficient platforms.
- Finding: In high uplink load scenarios, ARM architectures showed up to 2x better energy efficiency than traditional x86.
- Necessity: hardware acceleration (e.g., for FEC) is not optional but mandatory for high throughput.

Goal: Giving operators the data to make the right CAPEX/OPEX decisions.





Solutions for Brazil: Agro & Telemedicine

DOTERAN project

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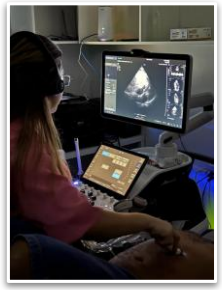
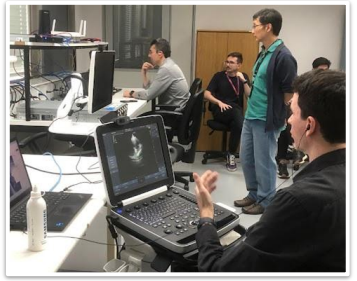
Telemedicine @ InovaHC

2.300 km distance (w/ Starlink)

and a 8.3 / 10 qualitative score

from the medical team





inova iHC Fmusp bp

SAMSUNG

Edge Sharing for Agro 4.0

Low latency Computer Vision app

with MEC sharing and local UPF

achieving < 20ms latency

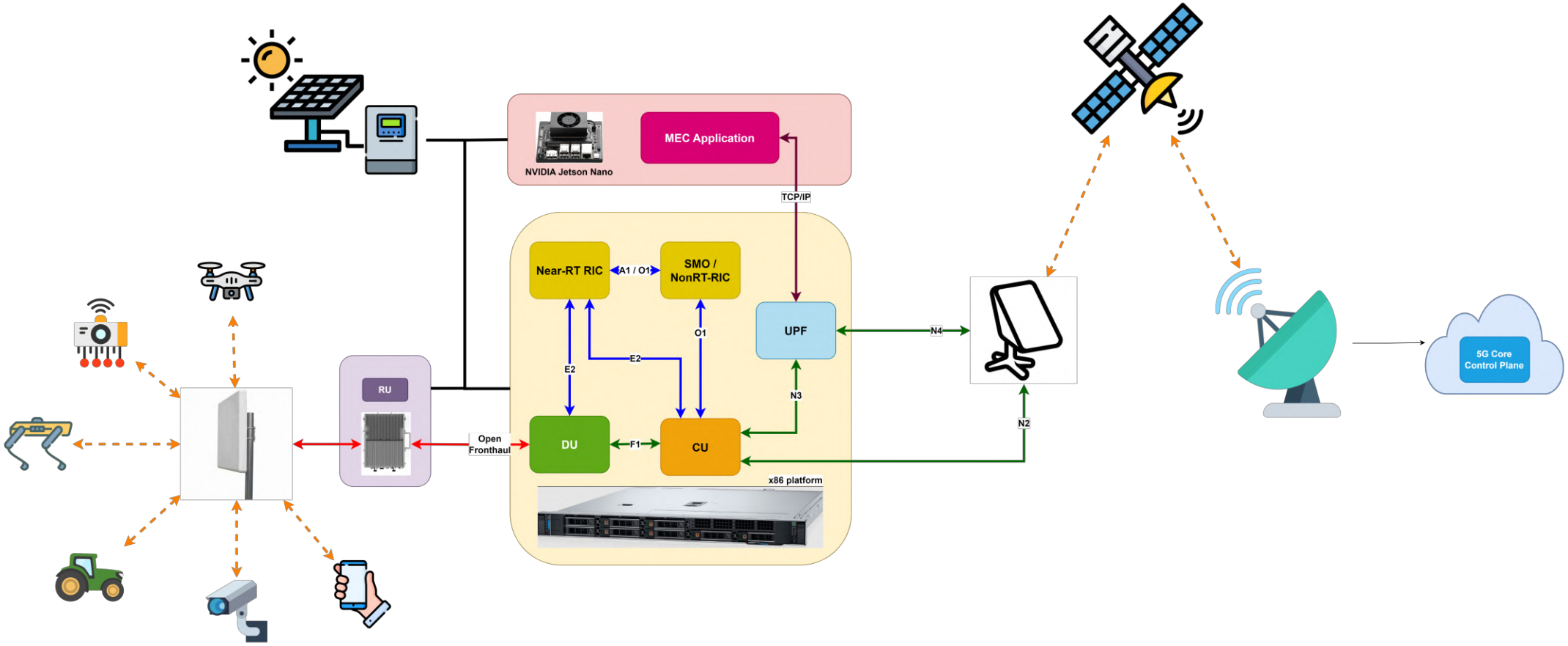

semear digital

Embrapa

Solutions for Brazil: Agro & Telemedicine

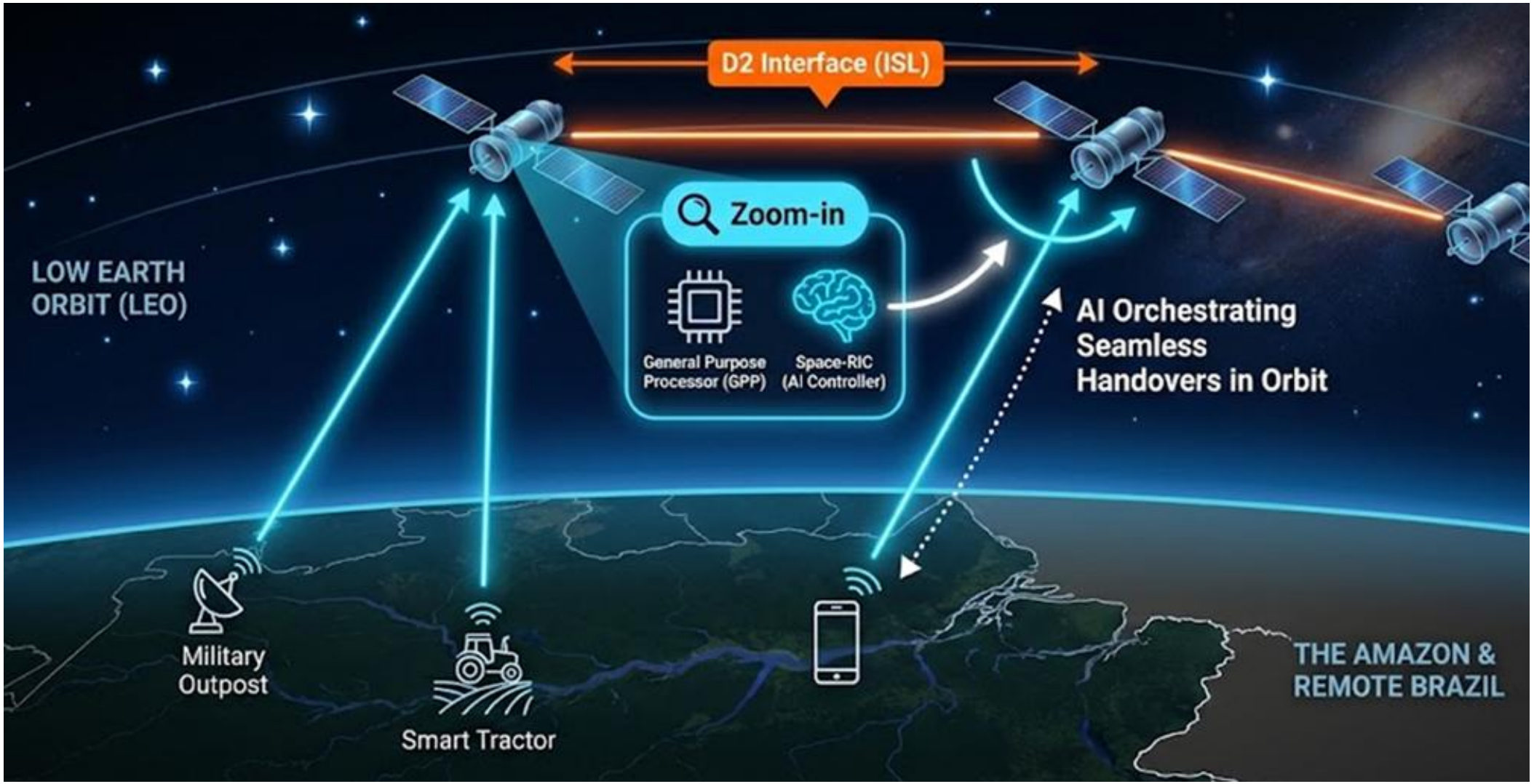
AgroRAN project

AgroRAN Project: Solar-powered Open RAN, shared MEC for RAN and Computer Vision application, satellite backhaul, AI for control and optimization (energy efficiency)



Beyond Terrestrial: Open RAN in Space

ORAN-Sat Project



Open RAN: Connecting the Dots with Partners

Upcoming Joint R&D Projects with other EMBRAPII Competence Centers

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SGHaul: Resilient Backhaul for Smart Grids

Problem: Lack of resilient, high-performance backhaul standards for Smart Grid AMI, specifically missing integration for IEEE 802.15.4 mesh networks.

Solution: EXCCON's 5G NR backhaul w/ Network Slicing + RIC (xApps/rApps) to segment AMI control (URLLC) vs. measurement (mMTC) traffic, plus FutureGrid's IEEE 802.15.4 Wi-SUN gateway.

ConneXR-FDT: Digital Twins for Immersive Apps

Problem: High cost and slowness in testing and prototyping Immersive XR applications over complex, dynamic mobile networks.

Solution: EXCCON's Mobile Network Digital Twin (MNDT) focusing on Open RAN w/ AI xApp for RIC for predictive resource orchestration + Akcit's Immersive Application Digital Twin (XR DT).

Open Gateway: Robotics and Programmaber 5G

Problem: "Difficulty ensuring Quality on Demand (QoS/QoD) in mobile networks for rigorous low-latency, high-reliability reqs of real-time remote robotics and Computer Vision.

Solution: EXCCON's Private 5G NR based on Open RAN. Integrate RIC (xApps/rApps) for resource optimization and SLA guarantees via Open Gateway API for xGMobile, CEDRA, Akcit and CISSA's applications

Conclusions & Future Outlook

The Road Ahead

EXCCON is not just testing technology; we are paving an open, disaggregated, virtualized and intelligent connectivity road for Brazil's digital future.

From Cloud Native automation (AUTORAN) to AI-driven Security (AITORAN) and Ultra-Real-Time control (RT-dApps), the goal is accessible, robust, and sovereign solutions.

Whether it's a clinic in the Amazon or a smart farm in the Midwest, Open RAN + AI is how we deliver meaningful connectivity!

Thank You!

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