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6G Networks: Pioneering Open Networks from Inception

CPQD

Largest R&D Center in Latin America
for ICT Technologies

An organization focused on
innovating with its customers



2023

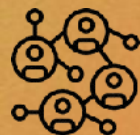
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PROGRAMS**

1st place in
Brazilian ranking

PATENT APPLICATIONS:

2nd place as an Innovation Center and
8th place as a National Organization

**49
Years**



**900
COLLABORATORS**



Why 6G?

New and Future applications: XR Streaming and Haptic Devices, Holographic Communications, Physical AI, UAV Comms, etc.

Old Challenges, New Promises: Ubiquitous Coverage, V2X, Remote Health, Industrial Connectivity, etc.

6G will be the network for Mobile Hybrid Computing : Enterprises and end users are increasingly adopting different architectures (CPUs, GPUs, TPUs, NPU, QPU) at different locations (Data Center, Edge Centers, Far Edge, Fog) for lower latency and enhanced processing power near data sources.



The oxygen for 6G: Spectrum Sharing Will Be Essential to Accommodate Different Demands

-  **Spectrum as a Scarce Resource:** 6G will operate in the upper midbands, requiring efficient use of available frequencies.
-  **Shared Spectrum Frameworks:** Use of models similar to CBRS (Citizen Broadband Radio Service) for flexible spectrum allocation.
-  **Collaboration for Efficiency:** Telecom operators, satellite operators, and government agencies must coordinate spectrum usage to avoid interference.
-  **Outcome:** Improved spectrum utilization for varied applications, from consumer broadband to critical infrastructure.



WRC-23 candidates:

4.4-4.8 GHz

7.1-8.4 GHz

14.8-15.35 GHz



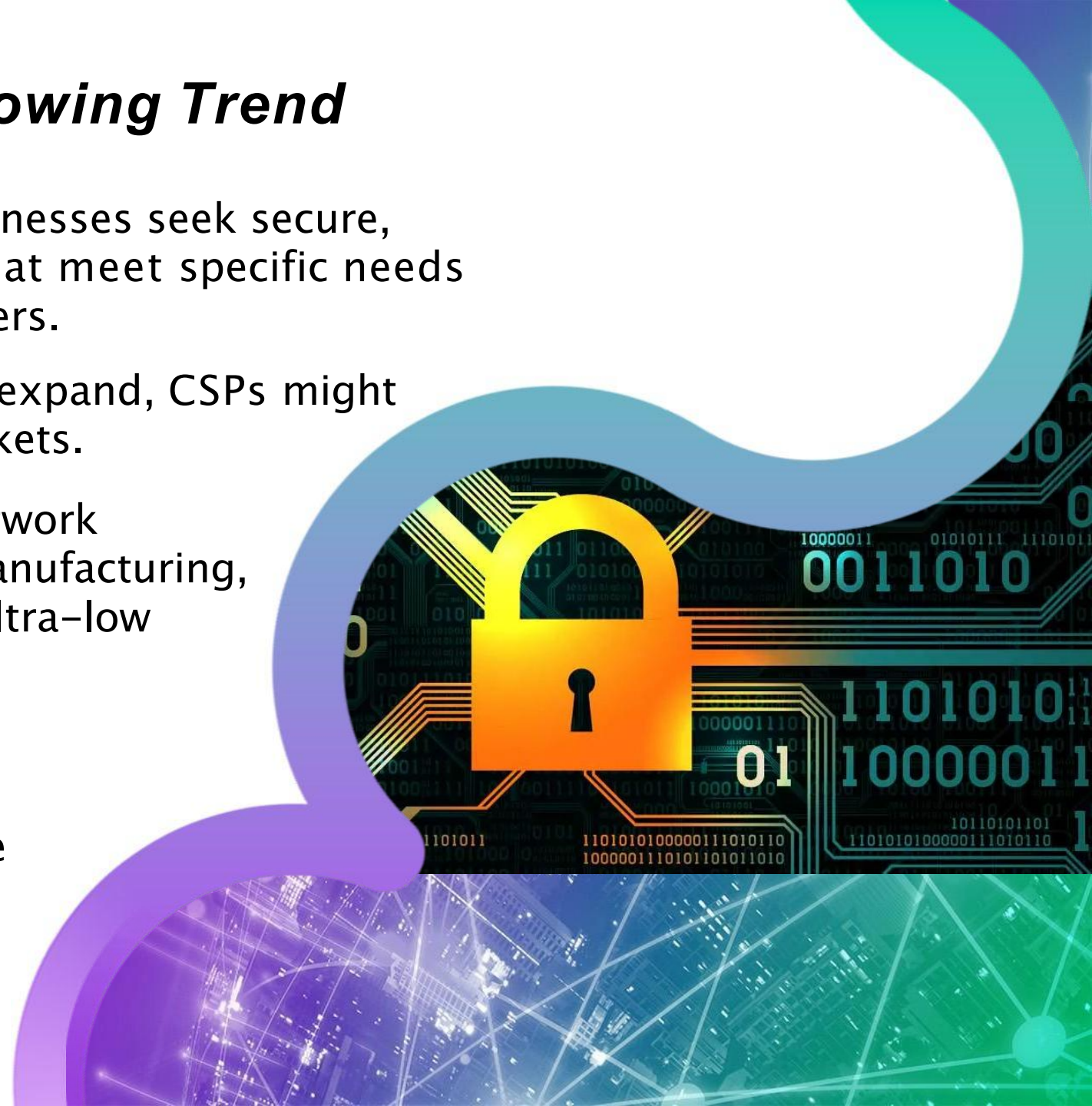
Private Networks Are a Growing Trend

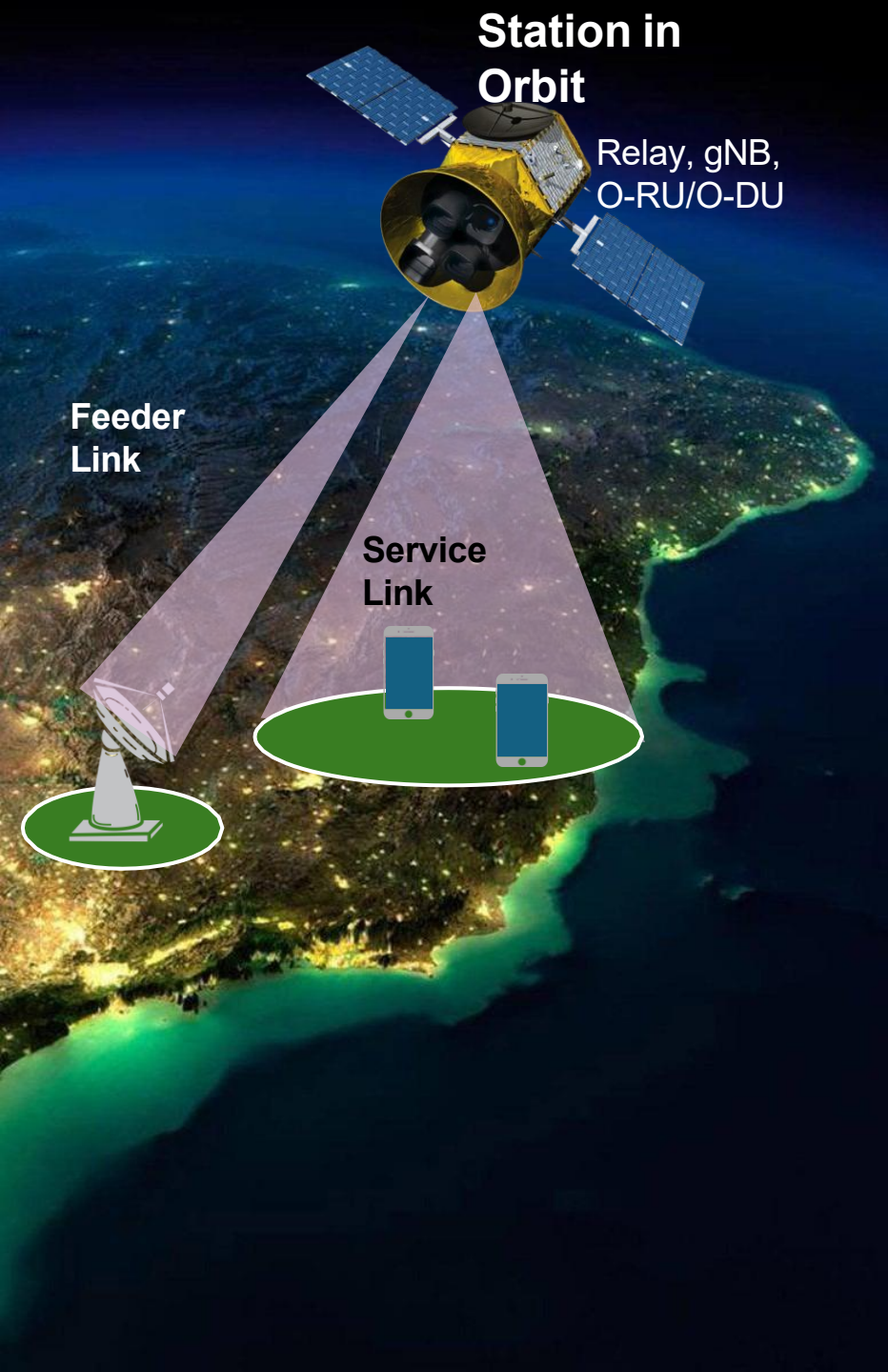
Rise of Private Cellular Networks: Businesses seek secure, reliable, and customizable networks that meet specific needs without depending on traditional carriers.

Impacts on CSPs: As private networks expand, CSPs might face reduced control over certain markets.

6G Implications: Enhanced private network capabilities will support sectors like manufacturing, logistics, and healthcare, leveraging ultra-low latency and high reliability.

Strategic Focus: 6G deployments will increasingly include dedicated spectrum and infrastructure for private enterprises.





Expansion of NTN Communication as a Solution for Uncovered Areas

Bridging the Digital Divide: NTN (Non-Terrestrial Networks), particularly satellite, will enhance connectivity in remote, underserved areas.

Complement to Terrestrial Networks: By integrating satellite services with 6G, users in previously inaccessible areas can access broadband, messaging, and essential services.

Spectrum Coordination will be paramount: Efficient sharing between satellite and terrestrial networks will be key to the convergence of both 6G layers.

Key Applications: Essential for IoT in agriculture, environmental monitoring, and remote healthcare.

Global Impact: Potential to significantly narrow the connectivity gap, reaching an estimated 800 million underserved individuals.

Intense Application of AI in the Network but also the Network for AI Applications

AI-Driven Optimization: AI and ML will optimize 6G network functions, manage bandwidth dynamically, and enable adaptive service quality.

Real-Time Network Adjustments: AI will support real-time model updates for optimizing and planning radio coverage, dynamic spectrum sharing, and proactive network maintenance.

Benefits for Industry Applications: Supports autonomous vehicles, smart cities, industrial IoT, and complex simulations (e.g., digital twins).

Strategic Advantage: AI enhances efficiency, resource allocation, and responsiveness, making networks smarter and more sustainable.

AI processing power shared: between the network and some applications.





Increasing Importance of Network Security: Resilience to Quantum Attacks (QKD and PQC)

Future-Proofing Against Quantum Threats: 6G will need advanced cryptographic measures like Quantum Key Distribution (QKD) and Post-Quantum Cryptography (PQC) to withstand quantum-based cyber threats.

Security-Driven Architecture: Resilience to quantum computing attacks will be essential to protect data integrity and privacy in 6G applications.

Government and Enterprise Demand: Security and privacy will drive adoption, especially in defense, finance, and critical infrastructure sectors.

Forward-Looking Strategy: Emphasizing quantum-resilient encryption ensures 6G remains secure, even as quantum computing evolves.



Open RAN

Standardized and Open Interfaces as a Catalyst for Cost Efficiency and ROI in 6G

Interoperability and Flexibility: Enabling multi-vendor solutions that reduce CAPEX and OPEX.

Modular Network Expansion: Facilitates incremental network growth, making it suitable for emerging 6G applications.

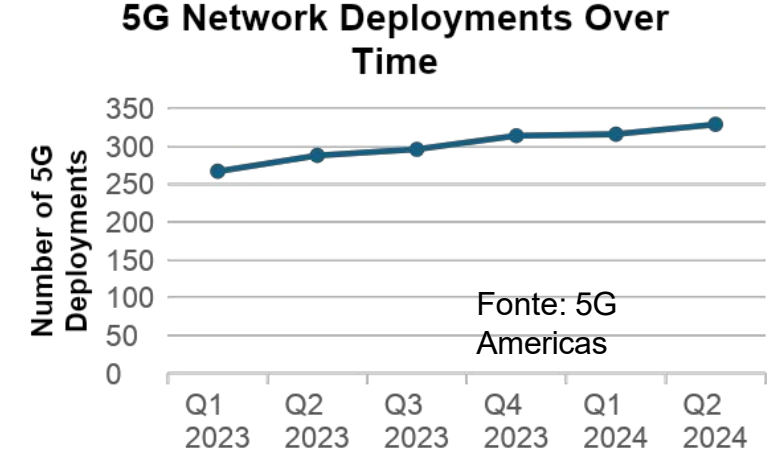
Strategic ROI Advantage: Supports diversified revenue streams through adaptable network architecture.

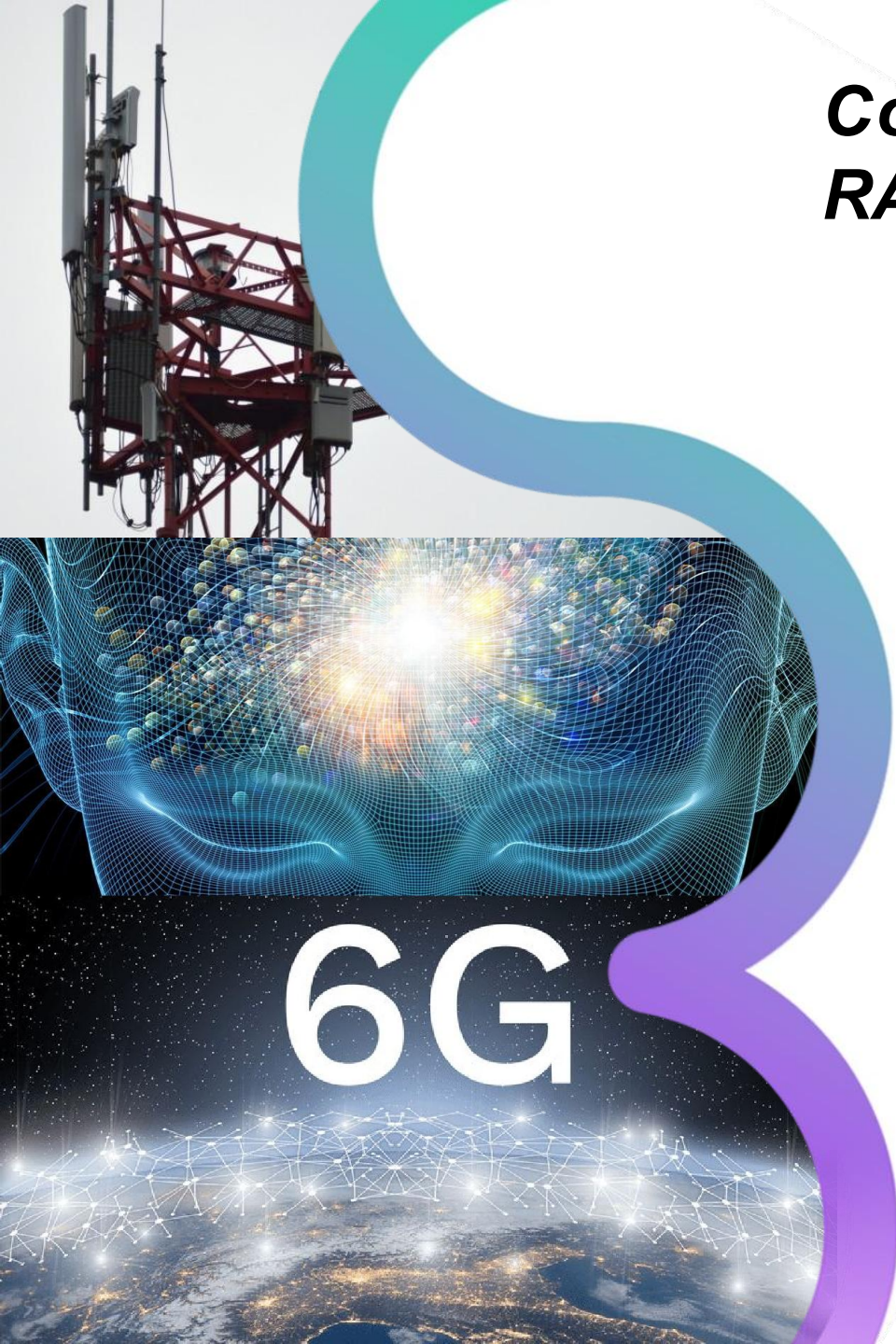
Accelerating 6G Adoption with Open RAN

Reduced Barriers to Entry: Open RAN allows smaller CSPs and enterprises to adopt 6G by lowering infrastructure costs.

Addressing the 5G Adoption Curve: Open architectures could counteract slow deployment cycles by enabling modular, demand-based rollouts.

Industrial and Private Network Potential: Open RAN makes it feasible for industries to implement private 6G networks tailored to specific applications.





Complexity vs. Adoption: Managing Open RAN in 6G Networks

Increased Complexity: Multi-vendor ecosystems require sophisticated integration and network orchestration.

AI and Automation as Solutions: AI can manage the complexity of Open RAN, enabling real-time network adjustments and optimal resource allocation.

Balancing Innovation with Manageability: Highlighting how Open RAN's benefits can be maximized with AI, improving overall adoption rates without sacrificing performance.

CPQD becomes an Open RAN benchmark in Brazil

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

Investments in the order of US\$ 25 M from EMBRAPII and FAPESP (50% each) are expected during the 42-month term of the agreement with the Excellence Centre, which will operate 4 lines of action:

- RD&I Projects
- HR training and education
- Attraction, Creation and Acceleration of startups
- Developing the Open RAN ecosystem based on the



Excellence Centre EMBRAPII CPQD in OPEN NETWORKS

THE 5 PILLARS OF CPQD ACTION



RD&I TECHNICAL COMPETENCE

R&D projects at the state-of-the-art of the Open RAN paradigm. Enhancement of the knowledge of the research team at the Excellence Centre.

Aims to accelerate technical-scientific readiness to overcome current and future technical and economic challenges in the evolution and dissemination of the Open RAN paradigm.

HR TRAINING AND EDUCATION

Training of new researchers and professional qualification for different actors in the ecosystem.

Actions focused on enhancing the intellectual capital of the Brazilian ecosystem. Joint action with members of the Technological Association, universities, associations, other Embrapii units, and Competence Centers.

TECHNOLOGICAL ASSOCIATION

Association in a broad open innovation initiative in Open RAN with benefits from the Center proportional to the invested capital.

Association that brings together different actors (suppliers, operators, ISPs, users of private networks, startups) interested in promoting, developing, and benefiting from this technology.

ATTRACTING AND CREATING STARTUPS

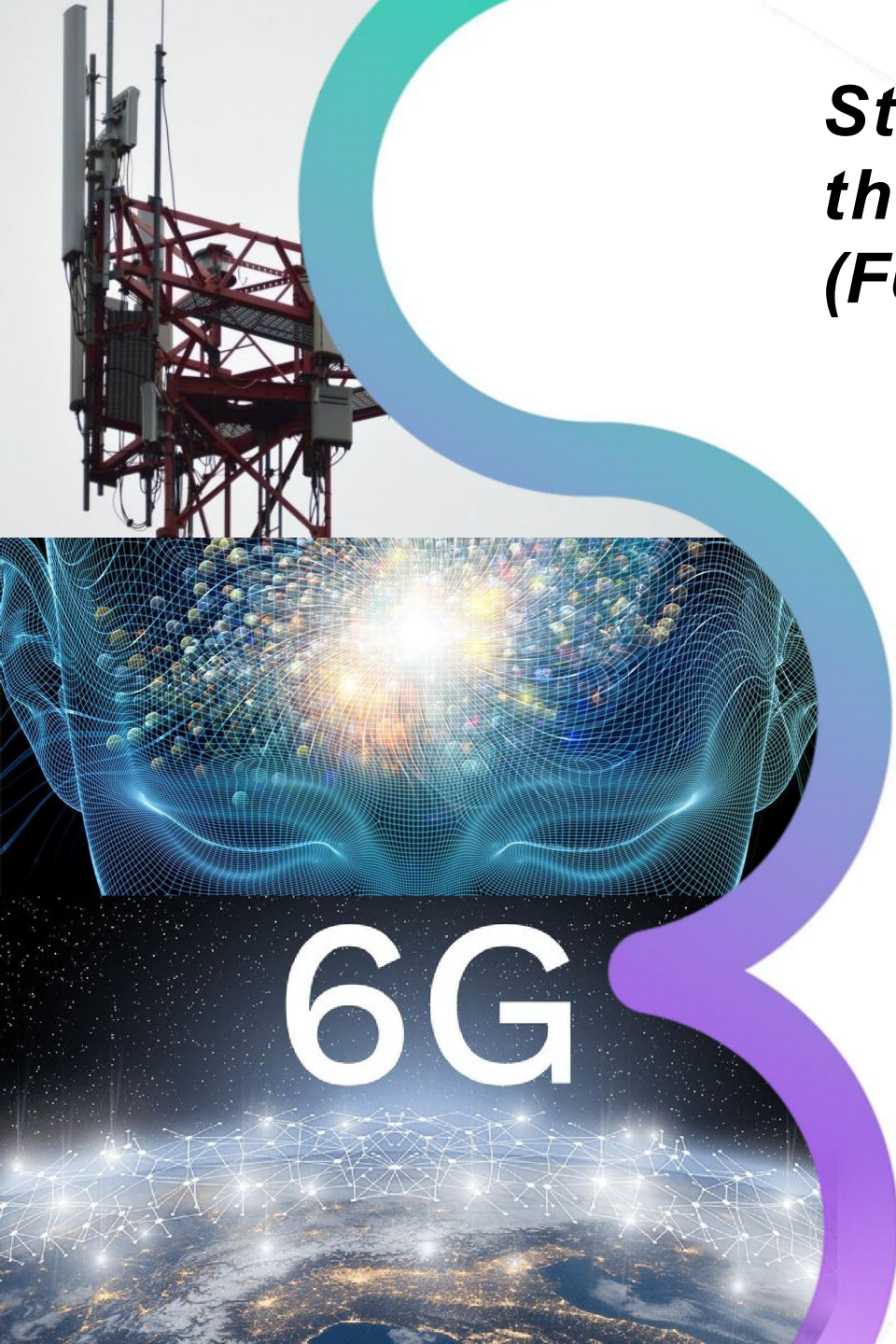
Action aimed at creating and accelerating startups that benefit from the results of the Center for their market insertion.

This action aims to stimulate the participation of startups in all activities of the Excellence Centre, with a view to assisting them in the development of innovative products and processes

TESTING AND INTEROPERABILITY INFRASTRUCTURE

Implementation of a national laboratory in Open RAN, and its approval as an OTIC in the ORAN Alliance.

Implementation of a national Open RAN lab, accredited as an OTIC by the O-RAN Alliance. Major challenges include interoperability among suppliers; and performance validation of these systems. OTICs (Open Testing and Interoperability Centre) are global reference laboratories for this purpose.



Structuring Projects at CPQD supported by the Telecommunication Innovation Fund (FUNTTEL)

Strategic Actions for Future Networks

(AERF): Explore the convergence between the Beyond 5G network and the future applications.

Telco AI (new): Generative AI applied to future network operation.

TeDesCon (new): DLT technologies applied to network operation and resources sharing.

ERA 6G (new): Explore new architectures and solutions for an organic and evolutive 6G deployment, focused in the economic sustainability of sites in low revenue areas.

Thank You

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