1st International Workshop on Open Research Infrastructures and Toolkits for 5G/6G R&D (OpenRIT 6G)

Opportunities and Challenges for 5G→6G
Prototyping & Research Platforms & Toolkits (in LatAm)

Alfonso Ehijo Benbow

University of O'Higgins, University of Chile

Cape Town, South Africa | 19-20 March 2024

Alfonso Ehijo - *Greetings from Chile!*
Master of Sciences, Electrical Engineer, University of Chile

Former CTO/Leader Technology Council - **TMX Internationa**l,
Engineering and Operations Manager, various **Operations.**
Expert Advisor in "TI-Car**e**" Industry
Expert Professor in Latest Technologies, UOH, UCH, UNAB
(Mobile Communications, Smart Cities, AI, EPS, etc)

Why Chile? Historic technology leader in the LA region, constantly at the forefront

1997 (AT&T-LA) → 2003 (AMX+TMX, CRT-Brazil) → 2009 (Santiago) ⇒ March 2024 (**Cape Town**)

Starting Point: UNIversity Future Internet 4G: 2012

Unifying **Education** and **Testbeds** around the Globe

www.av-tu-berlin.de

Hanoi University of Science and Technology

en.hustech.edu.vn

Universidad de Chile

www.uchile.cl

Ingeniería Eléctrica
FACULTAD DE CIENCIAS
FÍSICAS Y MATEMÁTICAS
UNIVERSIDAD DE CHILE

R&D
Lectures
Testbeds

R&D
Lectures
Testbeds

R&D
Lectures
Testbeds

R&D
Lectures
Testbeds

R&D
Lectures
Testbeds

Chulalongkorn University

www.chula.ac.th

Enabled by teagle
A Pan-European Laboratory Project

University of Cape Town

www.uct.ac.za

UNIversity Future Internet 6G: 2024 = "6G for ALL" TM

Sorbonne University

TU Berlin & Fraunhofer Institute FOKUS

Eurescom, Germany

Northeastern University & Rutgers University

University of Oulu

University of O'Higgins & University of Chile

Tokyo University

University of Cape Town

R&D
Lectures
Testbeds
Good weather!

Gwangju Institute of Science and Technology

UNIversity Future Internet 6G: 2024 = "6G for ALL" TM

Start simple with
a few strong and
sinergical partners.

The expansion of the
project and the number of
partners will come/follow
naturally as the **early
results** show up.

R&D
Lectures
Testbeds
Good weather!

Detecting the sinergies, the needs and the opportunities. Example:

Greetings from Oulu, Finland

6G

Introduction of the speaker

- Dr. Matti Hämäläinen
  - Centre for Wireless Communications – Networks and Systems, University of Oulu
  - Adjunct Professor (Docent)
    - docenture on wireless body area networks
  - Research focus: UWB, WBAN, radio propagation and channel modeling, medical ICT
  - Representing 6GFlagship
    - the 1st global 6G research programme
    - partly funded by the Research Council of Finland for eight years

~14000 km

2

The most important topic of this talk:

**Where and when are we going to meet ⟹
The next OpenRIT-6G will be in Latin America?**

To be more concrete:

Welcome to Chile!

Welcome to Chile! Excellent weather in September 2024 or March 2025

OpenRIT-6G Latin America: A whole continent to connect (enjoy!)

México: Ayayay!

Colombia: Qué chimba!

Brasil: Samba!

Argentina: Ché!

Let's go back to our OpenRIT 6G Capetown:
Only Technical Approach ? …
No way if we want to succed

Ultra Compact Local5G Softwarized System

NICT B5G Fund Project "Research and Development of B5G IoT SoC and IoT solution Building Platform of Continuous Evolution"
Grant #00801

- We have developed a low-power (W) integrated core and local 5G system that can be quickly installed outdoors with its small form factor (W) 173.2 x (H) 66 x (D) 274.2 mm (75% of A4 Paper Size)

- The recently announced development of an ultra-compact software-defined radio (SDR) board is embedded in a commercial general-purpose single-board computer to implement 5G functions, resulting in lower cost and flexibility in adding functions through software.

- We will accelerate the solution of social issues, search for potential needs, and value creation through confirming and verifying the usefulness in demonstrations using 5G/B5G communication devices.

4.7-4.9GHz /100MHz Sub6 5G 1W/ch total 2W
2x2 MIMO, Low-Power (90W) TDD SemiSync 1,2,3

Ultra-compact Software Defined Radio Board

- Accelerating Development of Programmable Base Stations Evolving with Software Expansion -

NICT B5G Fund Project "Research and Development of B5G IoT SoC and IoT solution Building Platform of Continuous Evolution"

Grant #00801

- We have successfully developed an "ultra-compact" software-defined radio (SDR) board that supports the development of next-generation communication standards .

- We have developed a board that supports M.2 standard interface, ultra-compact size (80mm long, 22mm wide , 5mm thick (board thickness 0.8mm)) and can be programmed with 5G and next-generation communication protocols.

- We will accelerate the resolution of social issues, the exploration of latent needs, and the creation of value through confirmation and verification of usefulness in demonstrations using 5G/B5G communication equipment that utilizes SDR.
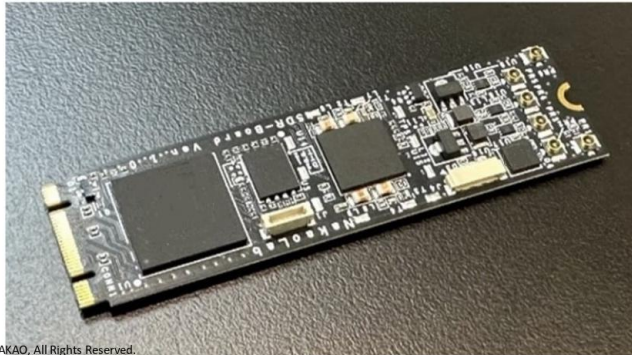
- ultra-compact: Compatible with M.2 standard.
- Height 80 mm, width 22 mm, thickness approx. 5 mm
- Flexibly add network functions through software
- Expand frequency bandwidth by daisy chaining multiple boards
- Confirmed to work as a 5G base station

NAKAO LAB

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Aki Nakao: Inclusive Creation of Next Generation Cyber Infrastructure

B5G Campus Testbed Concept

The strategy is to implement new ideas in society as quickly as possible and get feedback as quickly as possible.

- Testbed for democtratizing B5G network technologies
- Verification of social acceptability of technology
- Human resource development and industry-academia human resource circulation
- Promote interactive international collaboration to attract outstanding human resources

Closed Competitive Domains

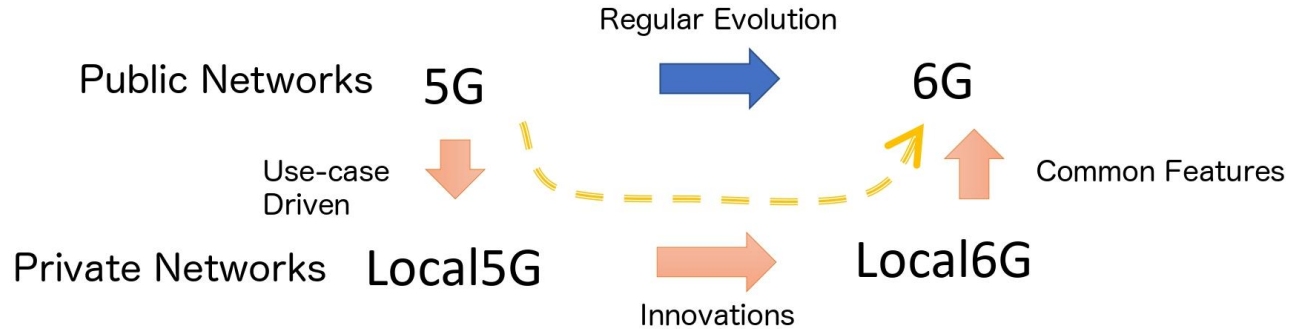| Company A | Company B | Company C | National Laboratory D | Foreign University | Foreign Research Lab | Standardization Body |

Open Cooperative Domain

B5G Campus Testbed Concept for Rapid Deployability First

NGCI: Collaborative Research Organization for Next-Generation Cyber Infrastructure
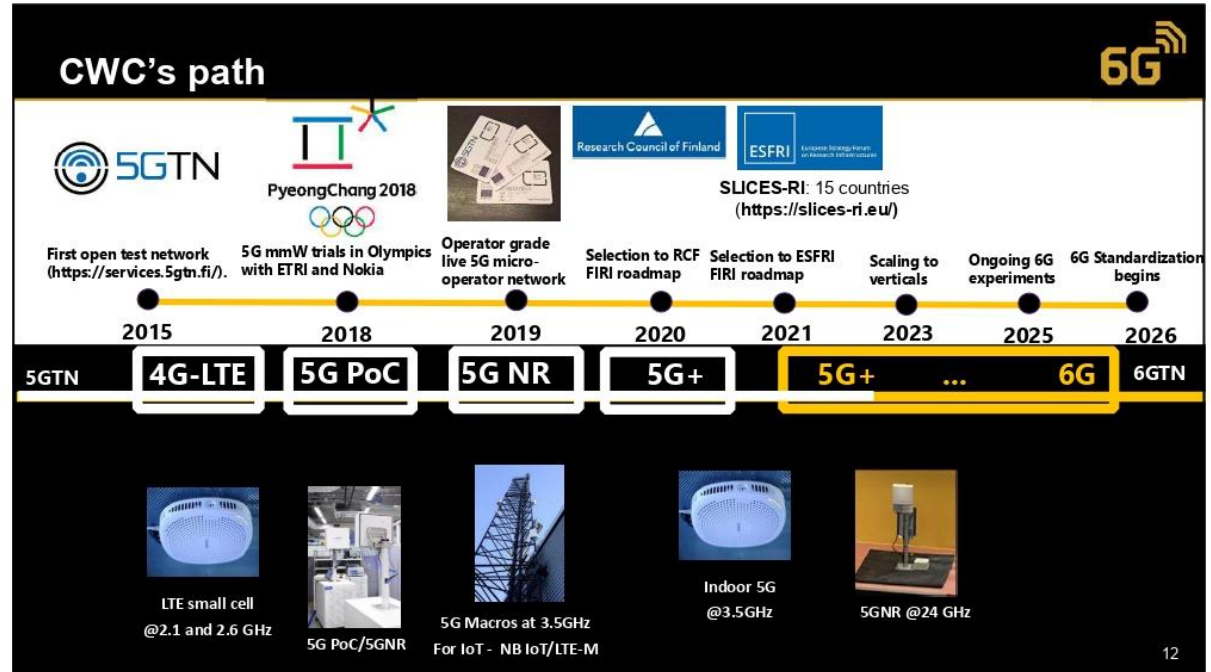
© 2021 Akihiro NAKAO, All Rights Reserved.

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Aki Nakao: Inclusive Creation of Next Generation Cyber Infrastructure

Democratization:
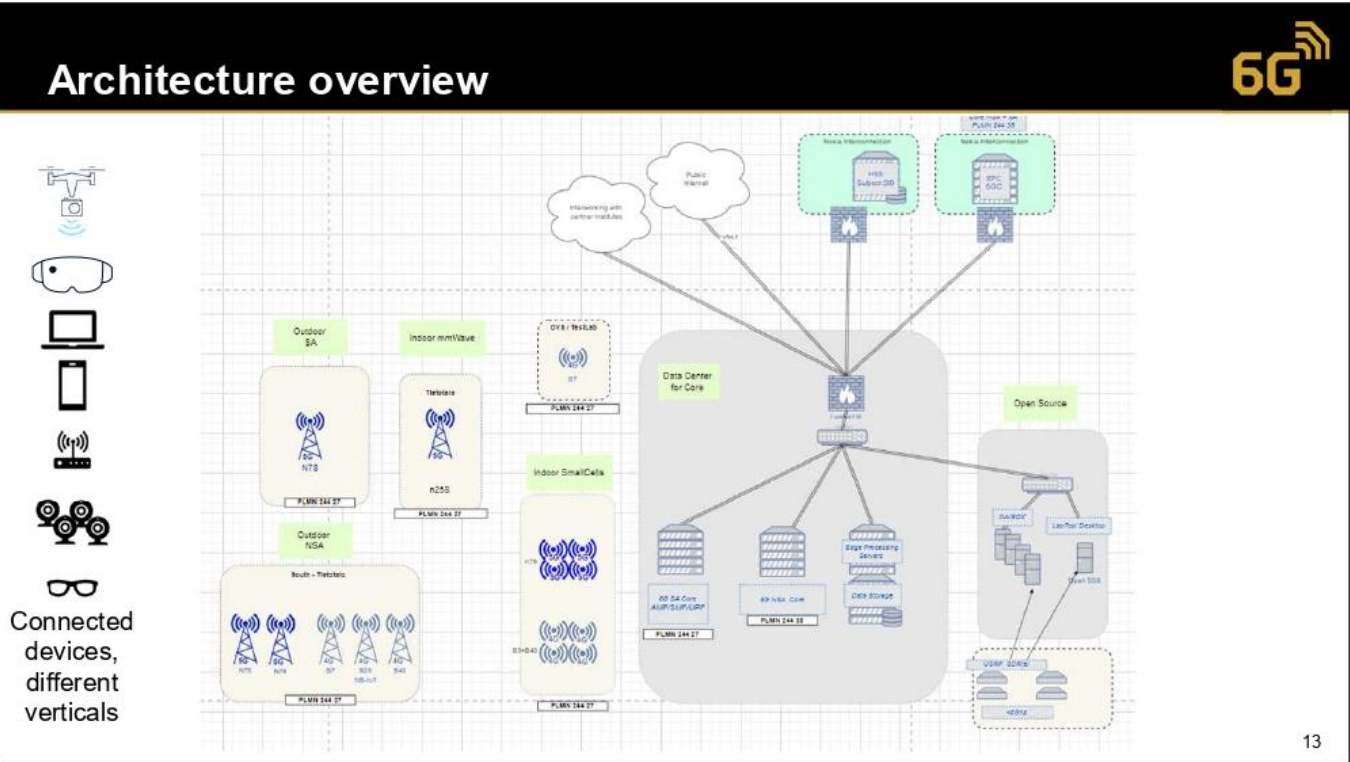6G will be driven bottom-up from Local6G / Private 6G

Regular Evolution

Public Networks 5G → 6G

Use-case
Driven

Common Features

Private Networks Local5G → Local6G

Innovations

Various Innovations driven by "customizations"

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Matti Hämäläinen: Being a 5G test network operator

Matti Hämäläinen: Being a 5G test network operator

Towards low-cost 5G-powered Telerobotic surgery

Telehaptics system enables the generation and transmission of touch sensations between distant locations.

Key requirements include low latency, consistent and stable haptic control, reliable haptic control over the network.
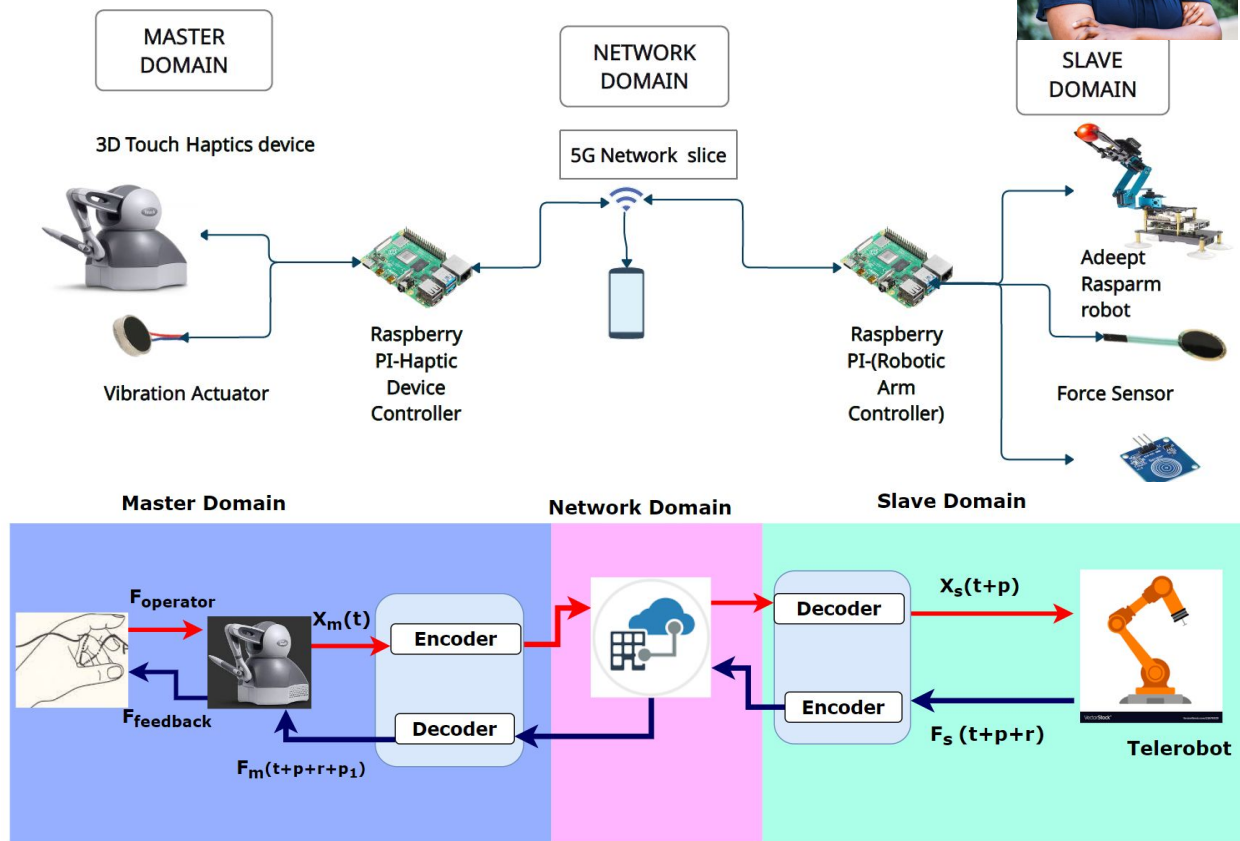
BUILDING THE NEXT-GENERATION OF INTELLIGENT SPECTRUM SHARING SYSTEMS

Automated Real-time Spectrum Management

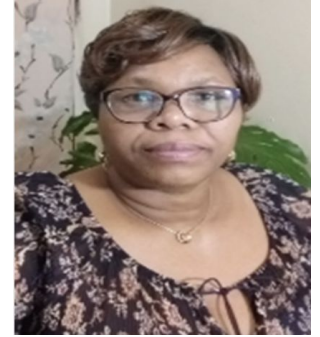| *Automation framework with O-RAN*	*xApp and rApps for spectrum management*	*dApps for real-time spectrum sensing*	*High-level orchestration and control*
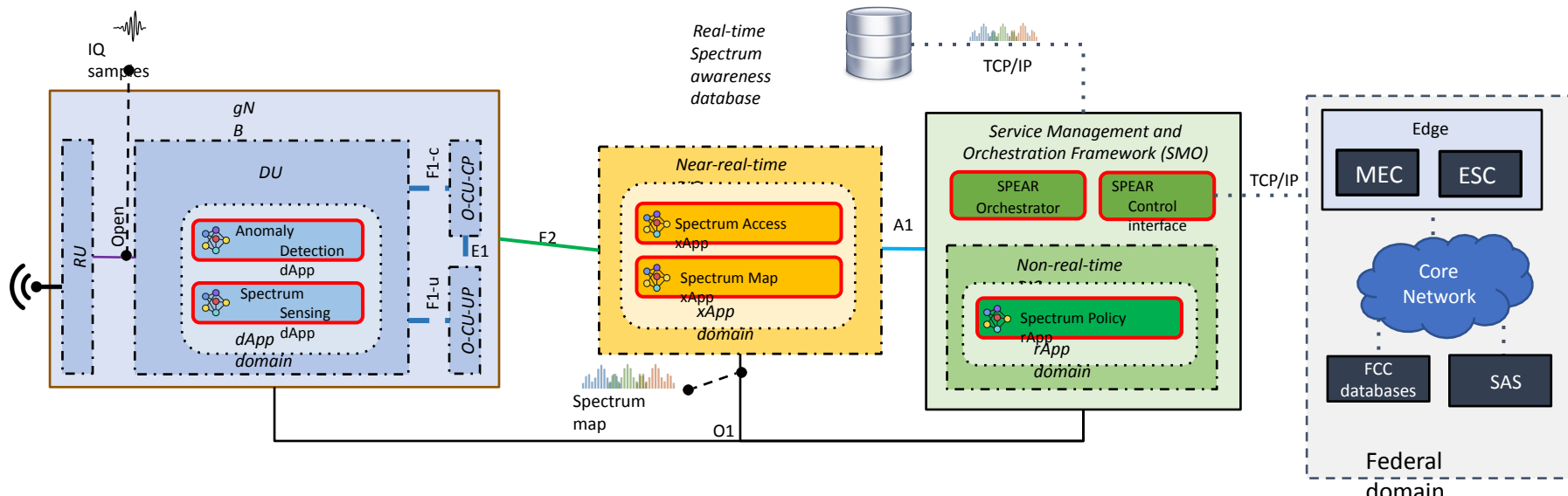
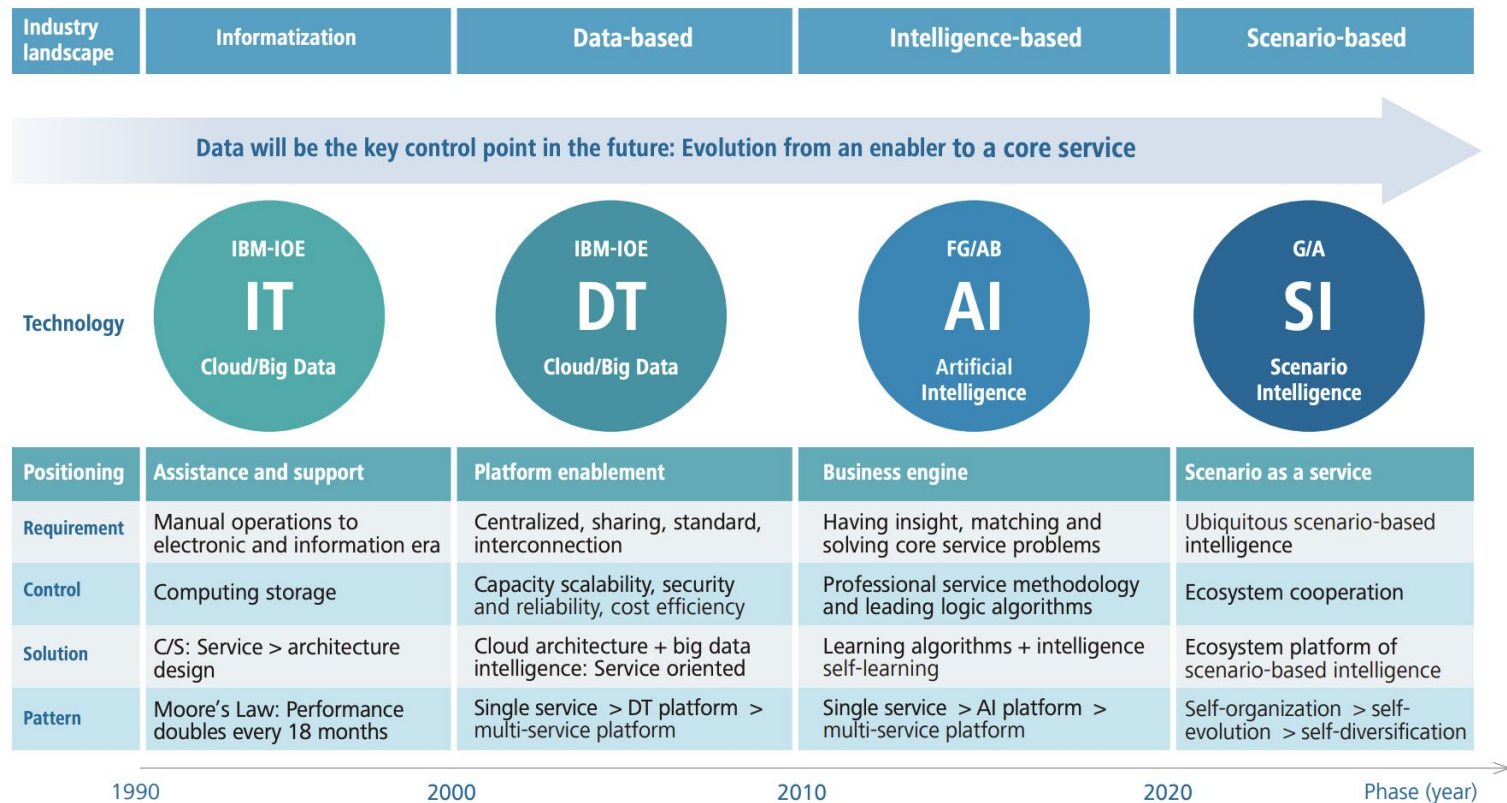**Techy oriented players/speakers. Few exceptions.**
⇒
Human+Techs Capabilities Catalogue/Inventory?

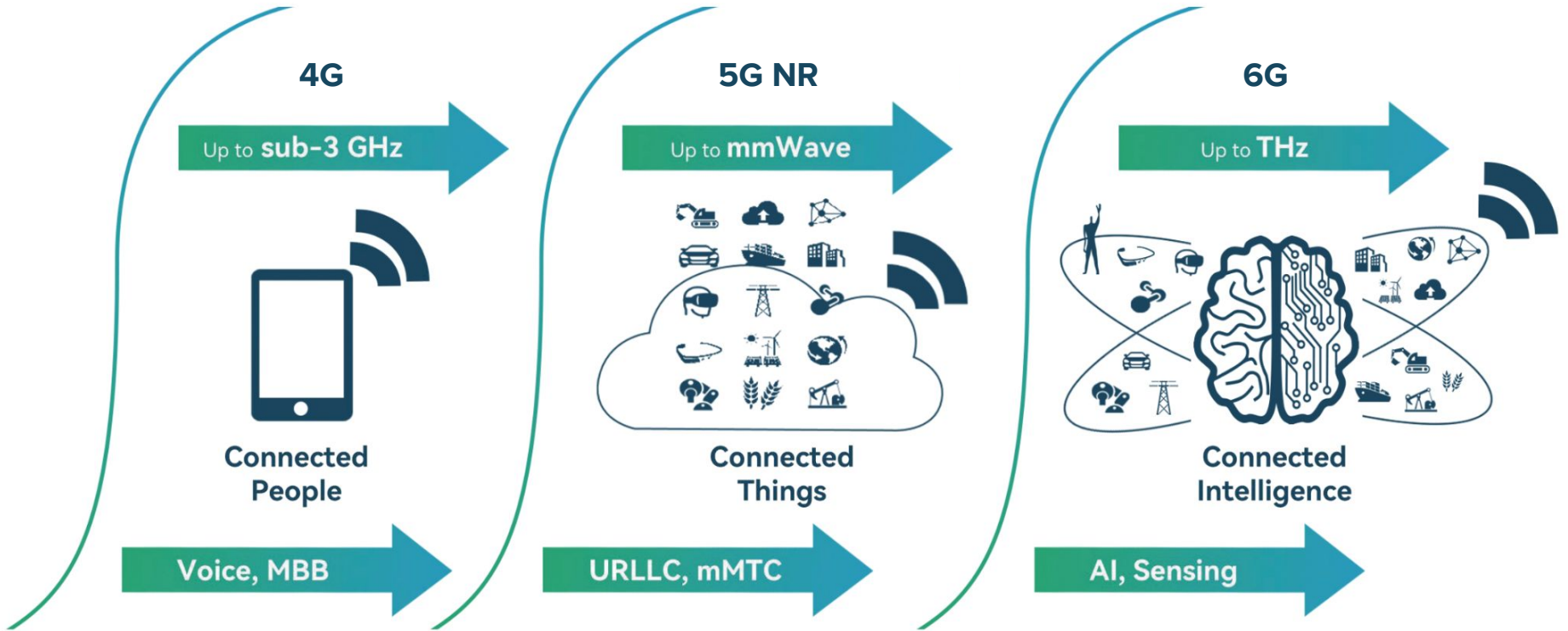# Sinergies, Intersections and gaps: Collaboration is a must!!!

Some important Context Elements from the ...
Telecom Industry
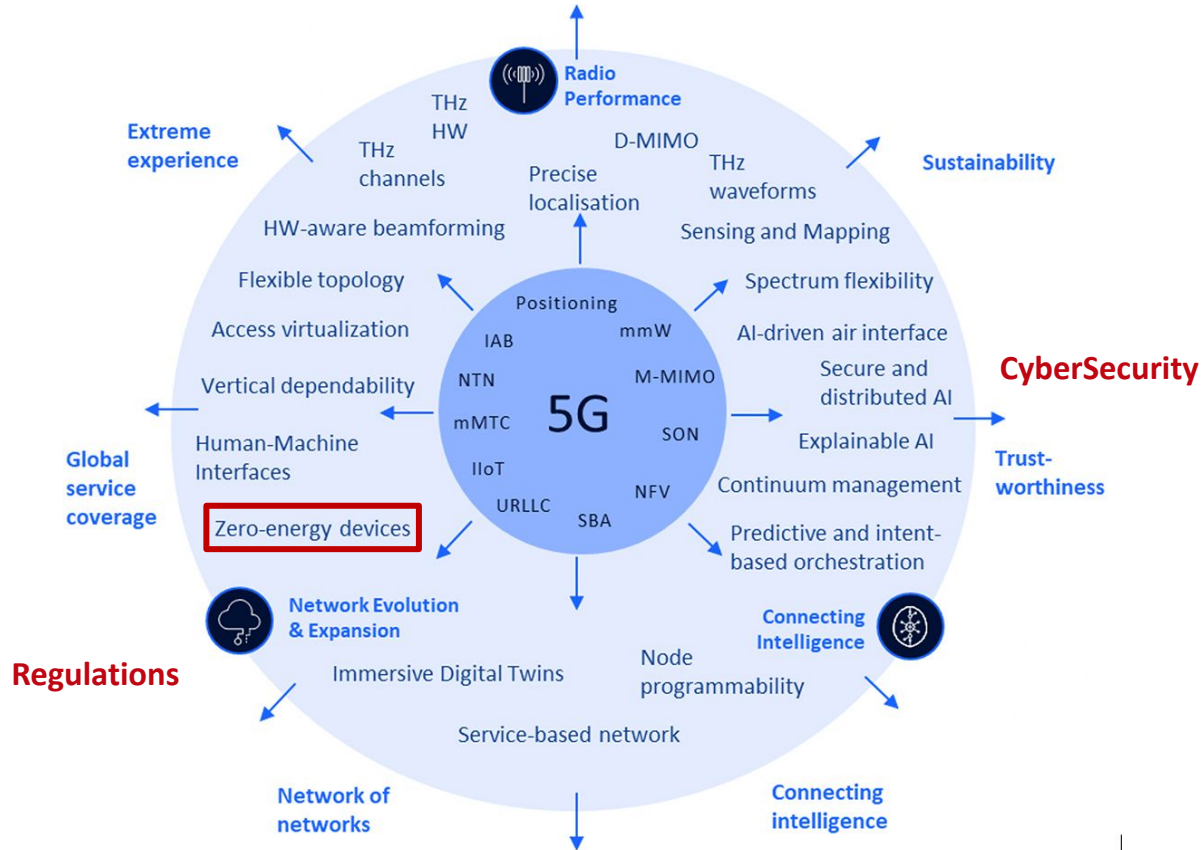
The four stages of ICT industry development

Industry landscape	Informatization	Data-based	Intelligence-based	Scenario-based

Data will be the key control point in the future: Evolution from an enabler **to a core service** →

Technology	IBM-IOE **IT** Cloud/Big Data	IBM-IOE **DT** Cloud/Big Data	FG/AB **AI** Artificial Intelligence	G/A **SI** Scenario Intelligence
Positioning	Assistance and support	Platform enablement	Business engine	Scenario as a service
Requirement	Manual operations to electronic and information era	Centralized, sharing, standard, interconnection	Having insight, matching and solving core service problems	Ubiquitous scenario-based intelligence
Control	Computing storage	Capacity scalability, security and reliability, cost efficiency	Professional service methodology and leading logic algorithms	Ecosystem cooperation
Solution	C/S: Service > architecture design	Cloud architecture + big data intelligence: Service oriented	Learning algorithms + intelligence self-learning	Ecosystem platform of scenario-based intelligence
Pattern	Moore's Law: Performance doubles every 18 months	Single service > DT platform > multi-service platform	Single service > AI platform > multi-service platform	Self-organization > self-evolution > self-diversification

1990	2000	2010	2020	Phase (year)

Source: https://www-file.huawei.com/-/media/corporate/pdf/publications/communicate/81/81-en.pdf

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From 5G to 6G: A real and ongoing evolution

4G — Up to sub-3 GHz — Voice, MBB — Connected People

5G NR — Up to mmWave — URLLC, mMTC — Connected Things

6G — Up to THz — AI, Sensing — Connected Intelligence

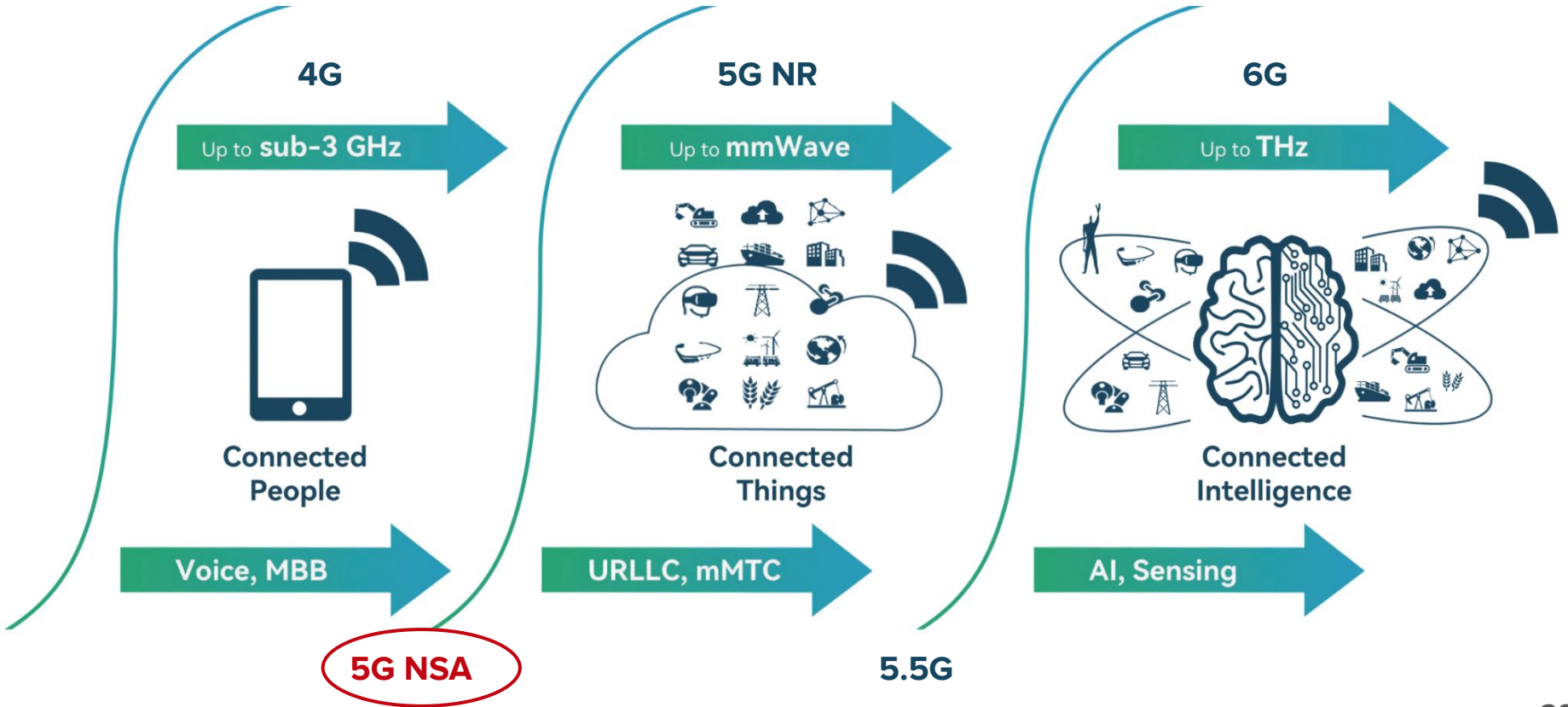Source: https://www.huawei.com/en/huaweitech/future-technologies/6g-white-paper

From 5G to 6G: Inspiration for our OpenRIT 6G opportunities and challenges

But now, what do we do with all the operators that are still in 5G NSA?

4G

Up to **sub-3 GHz**

Voice, MBB

Connected People

5G NR

Up to **mmWave**

URLLC, mMTC

Connected Things

6G

Up to **THz**

AI, Sensing

Connected Intelligence

5G NSA

5.5G

Operators investing in 5G SA for public networks and in any 3GPP 5G network

5G **5G SA**

Chart values:

Quarter	5G	5G SA
3Q20	402	52
4Q20	412	61
1Q21	428	68
2Q21	453	82
3Q21	464	89
4Q21	481	99
1Q22	491	102
2Q22	496	108
3Q22	505	111
4Q22	515	112
1Q23	524	115
2Q23	535	115
3Q23	578	121
4Q23	582	121
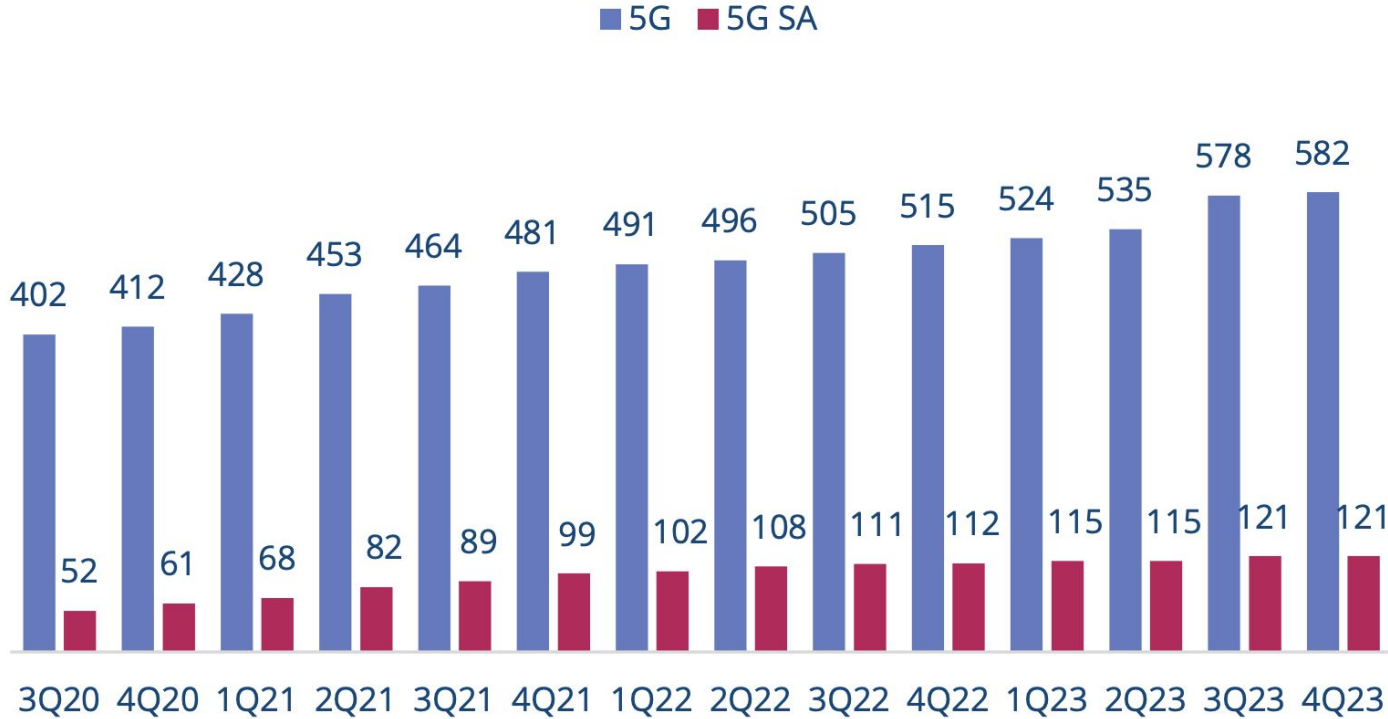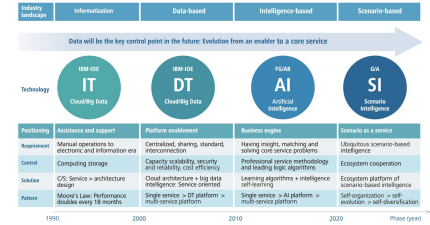
New business model?

461 global operators without 5G SA

And what about Latin America? 31 countries remain on 5G Release 15

- Formed by **33** countries + **13** islands, from Mexico to Chile

- Only two countries are investing in 5G SA: Brazil and Colombia

- So... **31** countries remain on 5G Release 15!

Source: https://gsacom.com/paper/5g-standalone-january-2024-summary/

And what about Latin America? 1.869 Universities

According to the uniRank database in **2023** there are currently **1,869** officially recognized higher-education institutions in Latin America. Considering that the uniRank database includes a total number of **13,837** officially recognized higher education institutions the proportion of Latin American Universities in the world is as follows:

- uniRank Latin American Universities World Representation Index: **13.5%**

Source: https://gsacom.com/paper/5g-standalone-january-2024-summary/

Why Chile? 21 5G labs, driven by the Flexible/Agile Regulator, Operators and Universities
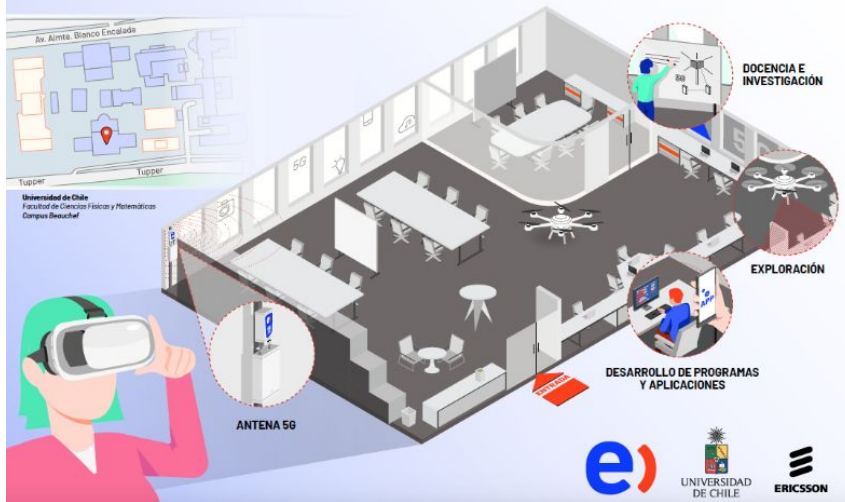
So why are operators still stuck on 5G NSA (e.g. LatAm)?

- Many operators still have the old "telecoms" vision
- Operators unwilling to invest without seeing a clear ROI
- ROI or die: the 5G imperative for telecoms
- High O&M costs for today's networks
- **No clear use cases to justify 5G SA!**

IBC365

MWC 2024: 5G still awaits killer app as mobile industry looks to AI

AI was the buzz at Mobile World Congress 2024, but making a return on their 5G investment was at the forefront of operators' minds.

Source: https://www.ibc.org/features/mwc-2024-5g-still-awaits-killer-app-as-mobile-industry-looks-to-ai/10768.article

How we manage the Latin American side of the ... Project (UNIFI-6G)

Positioning Chile as a starting point and a hub for LatAm!

5G 6G

Smart Distributed Architecture: Prototyping & Research Platforms & Toolkits (in LatAm)

"A federated ecosystem in Latin America for the prototyping and testing of 6G applications and portable testbeds. This initiative aims to forge a robust collaboration between multiple partners, including universities, regulators, telecom operators and vendors, to drive the transition from 5G NSA-6G. " ⇒ *Chile is the Smart HUB.*
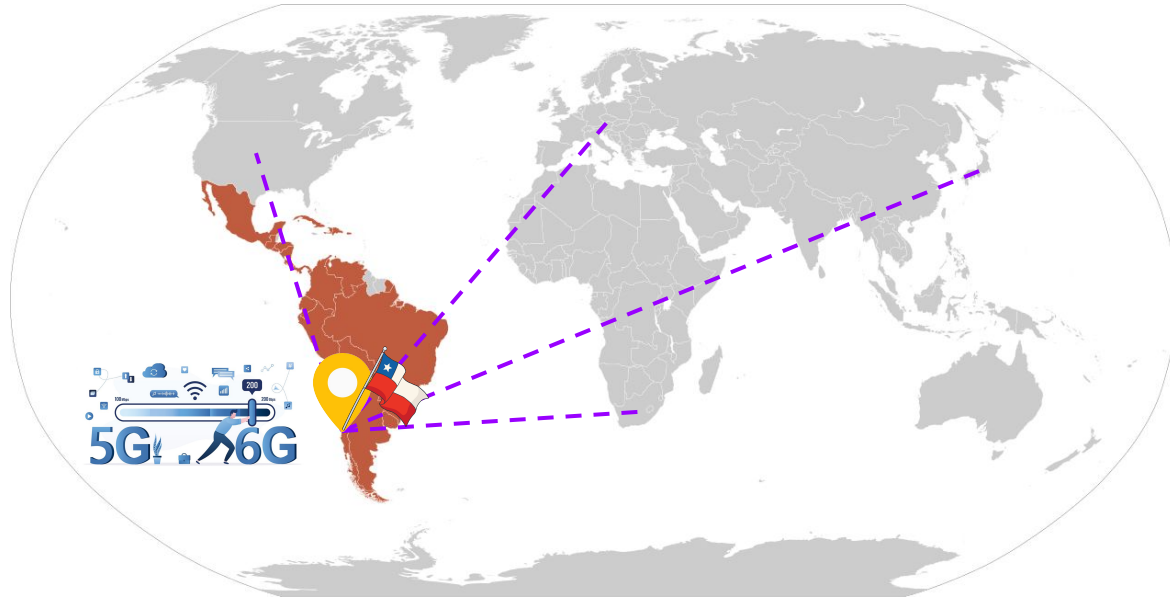
Positioning Chile as a starting point and a hub for LatAm!

OK

Smart Agriculture

???

NTN Networks

New Spectrum and Topologies
Upper mid-band, sub-THz, intelligent spectrum sharing, LEO/GEO Satellite networks, Cell-Free Massive MIMO, Full Duplex, Mobile mesh networks

End-to-End Cloud Native
Distributed cloud platform, Cloud-native Network Automated Test to Assurance, Network Disaggregation

Native AI/ML End-to-End
AI/ML across the entire network, from PHY to MAC to network, all the way to Optimization to Management

6G

Security and Resilience
Zero-trust principles, post-quantum security, resilient infrastructure

Expanded Verticals
AR/VR (Metaverse), Precision sensing and localization for automotive and IIOT

Optical-Wireless Coalescence
All-photonics networks, free-space optical communications, radio-over-fiber

OK

Smart Mining

Some examples of the key players in CHILE:

Regulator, operators, vendors, Instrument providers and …
*… **Universities** are the key players.*

Federated Ecosystem in LatAm

Collaboration between multiple partners

6G applications & portable testbeds

Prototyping & Testing
CyberSecurity_1 in 5G→6G

Transition 5G NSA→6G

Technical complexities & business challenges

AI-driven telecom
(e.g.: AI-RAN)

Training laboratories & showcases for telcos

ROHDE & SCHWARZ

HUAWEI

VIAVI Solutions

KEYSIGHT TECHNOLOGIES

ERICSSON

Telefónica

entel

Claro

Telconsur

Subsecretaría de Telecomunicaciones
Gobierno de Chile

CORFO

Fraunhofer

Universidad de O'Higgins

UNIVERSIDAD DE CHILE

Universidad Andrés Bello

FSO, VLC

NTN Networks

5G NSA, 5G SA, 5.5G, 6G

AI/ML at the edge and smart sensors
Digital Twins?

Energy & Power cons.

Cybersecurity_2
(including Quantum C)

Smart Cities, Smart Industry

Universidad de O'Higgins

5G 6G
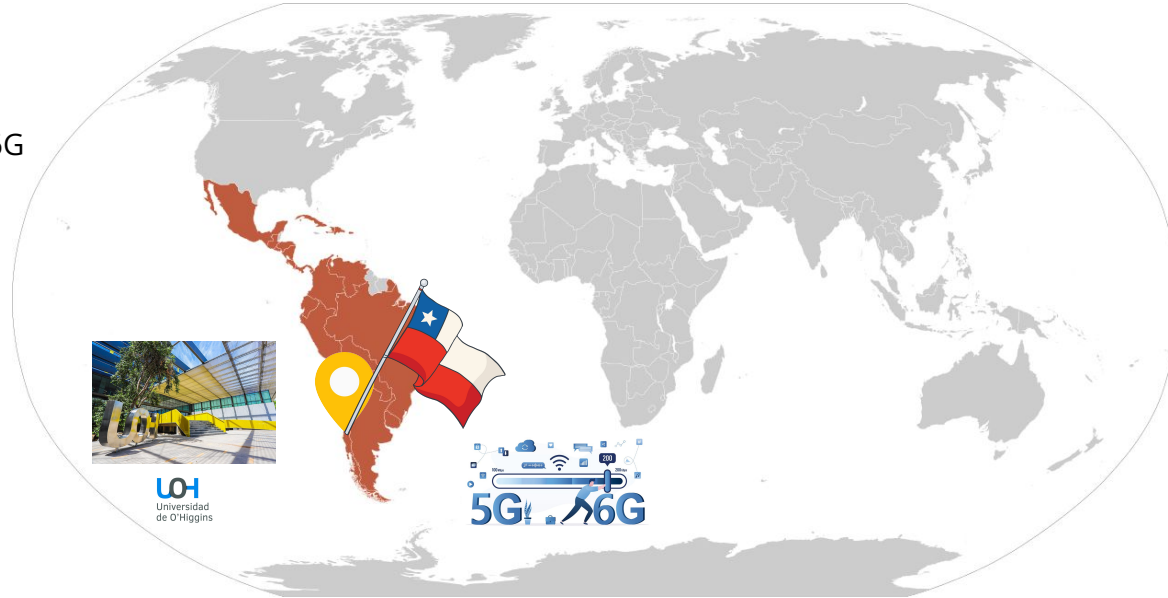
Pains, threats, (opportunities and challenges) for Traditional Telcos … Other opportunitie$

7 Major Telecom Pain Points

1 Data Segmentation and Redundancy

2 Low Customer Outreach and Conversion

3 Lack of Agile System Integration

4 Poor Efficiency and High Operational Costs
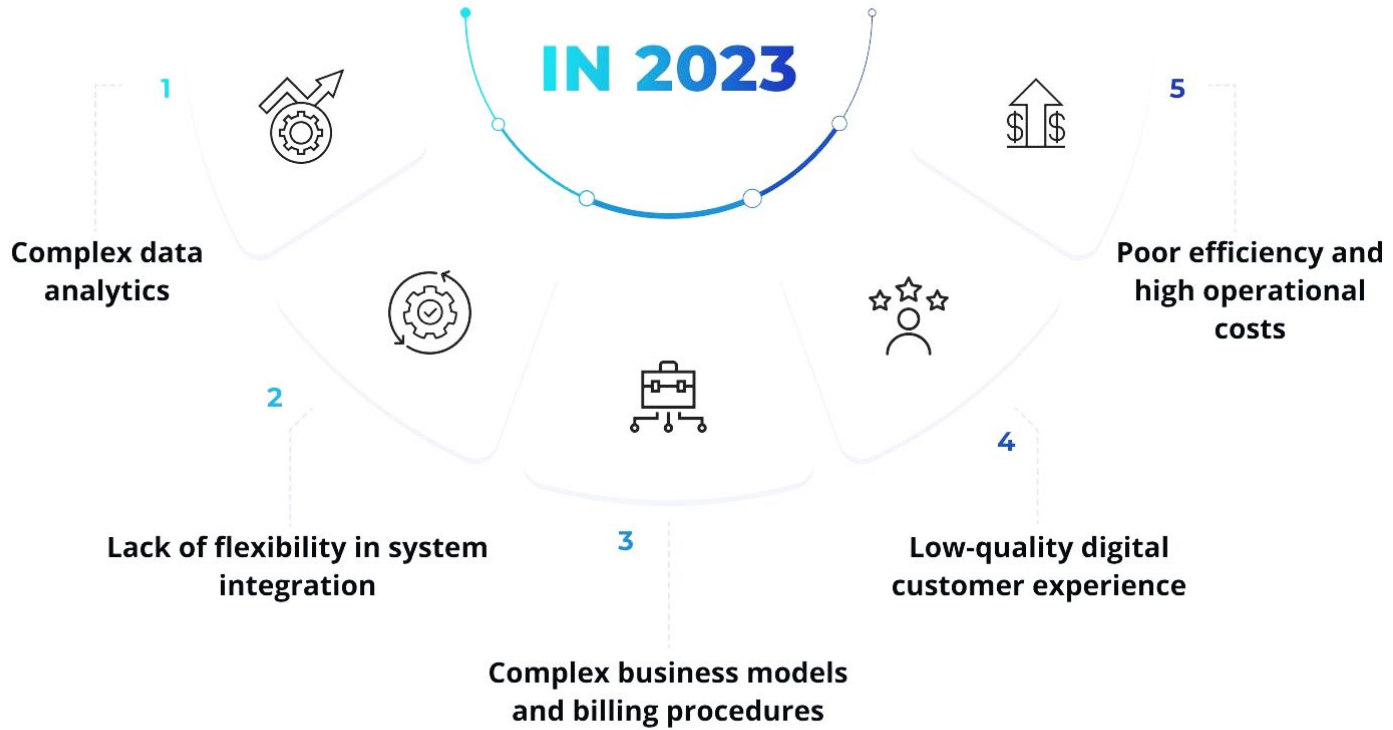
5 Technological Expertise and R&D

6 Edge Computing - New Architectural Challenges

7 Digital Twins Are Reshaping the Foundations

Anothers Telecom Pain Points

IN 2023

1 Complex data analytics

2 Lack of flexibility in system integration

3 Complex business models and billing procedures

4 Low-quality digital customer experience

5 Poor efficiency and high operational costs

Areas where Telcos must transform to survive and thrive

1. Virtualisation of the network

2. Data driven

3. Open platform

4. Flexible and adaptive business models

5. Product and partner aggregation

6. Omni channel

7. Speed of change

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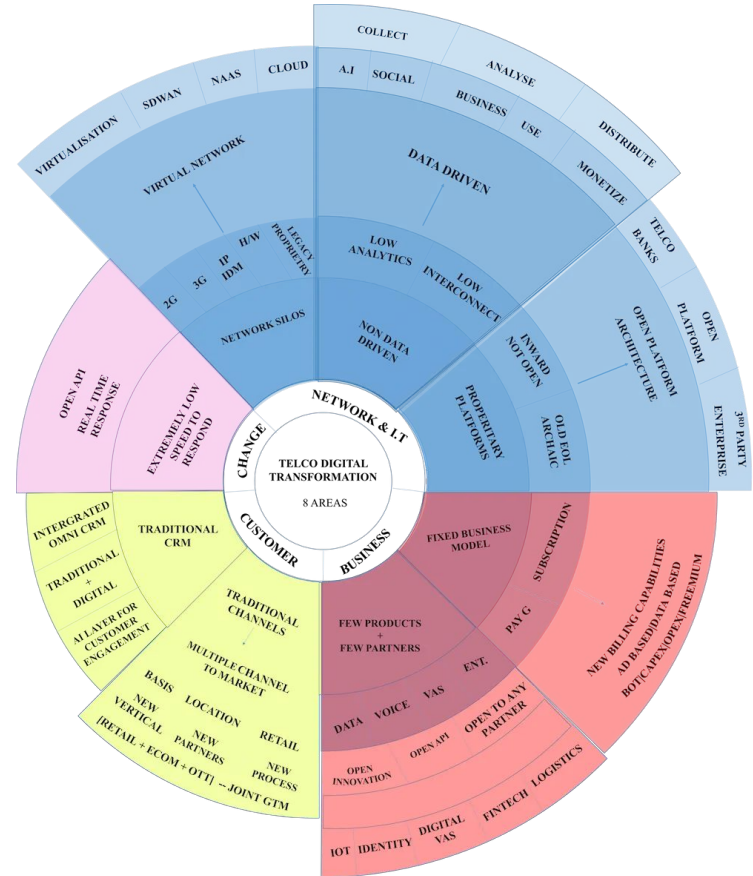
The Six Telco 2.0 Opportunity Areas

Core services

- Redefine the customer experience for telecoms via:
  - Improvement of core product portfolio, more engaging marketing, leveraging of online sales channels, enhanced customer interaction and care

Vertical industry solutions (SI)

- Extend from telecoms into IT and networking for corporate clients via 'verticalised' solutions

Infrastructure services

- Expand and extend wholesale and corporate offerings from network to infrastructure:
  - Provide infrastructure services such as mobile offload, data centre capabilities etc. to other operators and to corporate customers

Embedded communications

- Integrate voice, messaging, and connectivity services into those of third parties:
  - Communications-enabled business processes, voice and messaging integrated with games (for example), M2M and embedded mobility connectivity
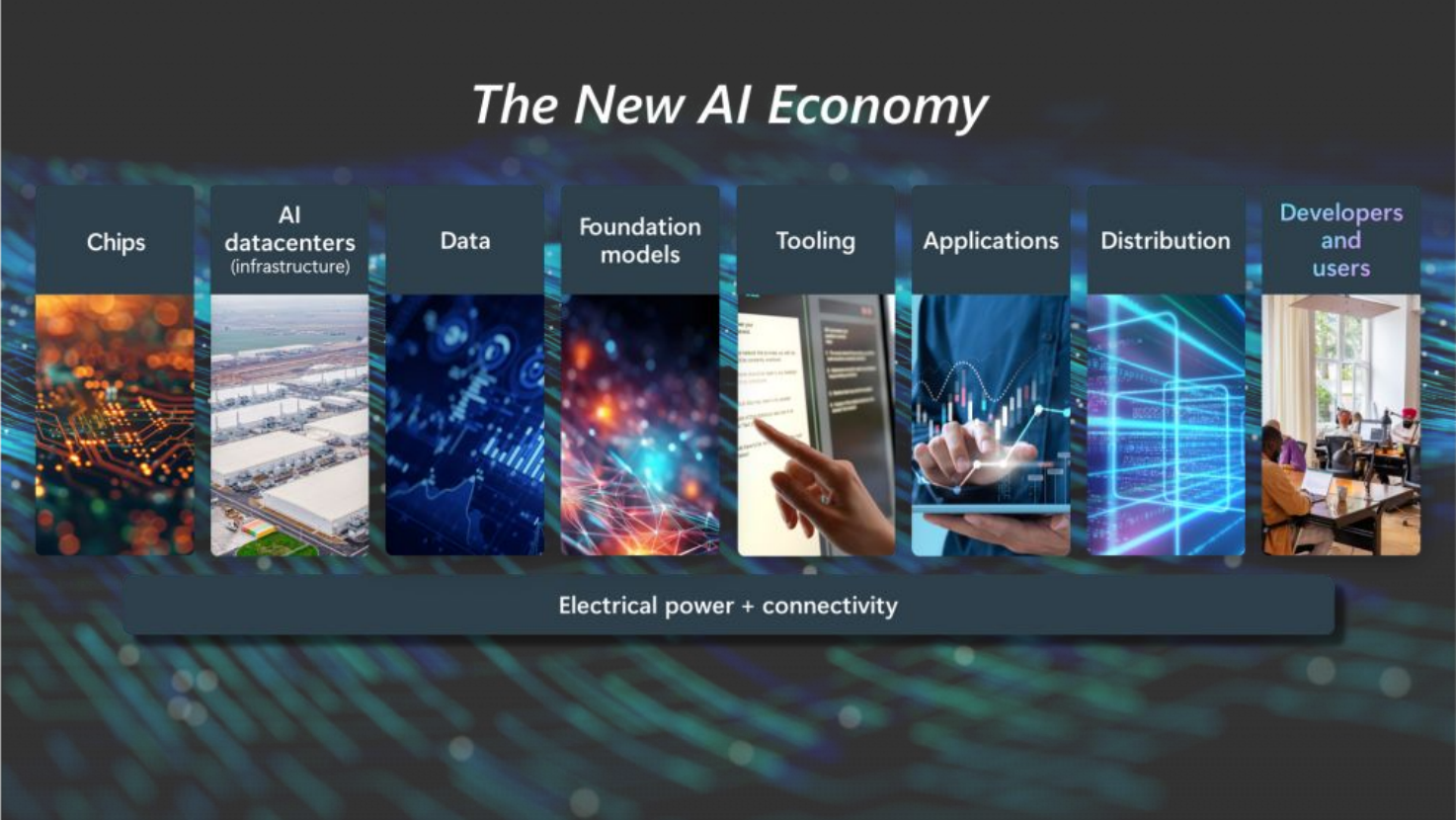
Third-party business enablers

- Make (latent) telco capabilities available to third-party service providers:
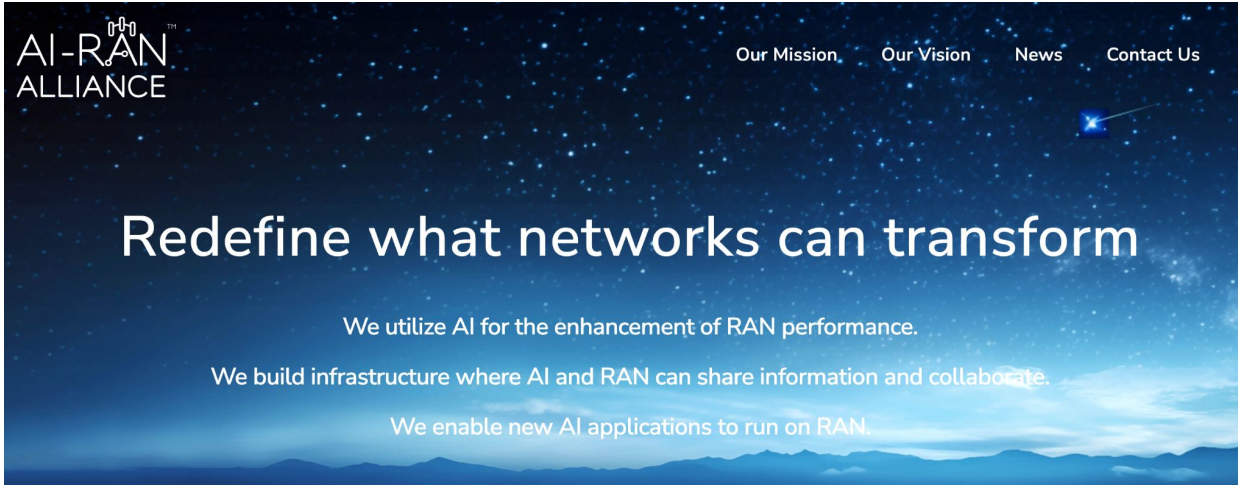 - Identify & authentication; marketing & advertising; payments; customer care

Own brand OTT services

- Develop network-independent applications and services:
  - Copy internet players and provide valuable applications and services 'OTT' – could be free or paid-for

AI was one of the big winners at MWC 2024 in Barcelona!

The New AI Economy

Chips | AI datacenters (infrastructure) | Data | Foundation models | Tooling | Applications | Distribution | Developers and users

Electrical power + connectivity

AI-RAN Alliance: the holy grail or a catastrophic failure? Interoperability issues

Source: https://ai-ran.org/

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de O'Higgins

UNIVERSIDAD DE CHILE