

WIRELESS WORLD
RESEARCH FORUM

HUDDLE 2025

Radio Access on the road to 6G

Spectrum Sensing and Coexistence with Legacy Technologies

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About Inatel

Engineering University
focusing on Information
and Communication
Technologies.

Research and development
of 5G and 6G networks.

Leader of the Brasil 6G and
xGMobile research projects



Why do we need a 6G Network?

- Very high expectation created for 5G networks.

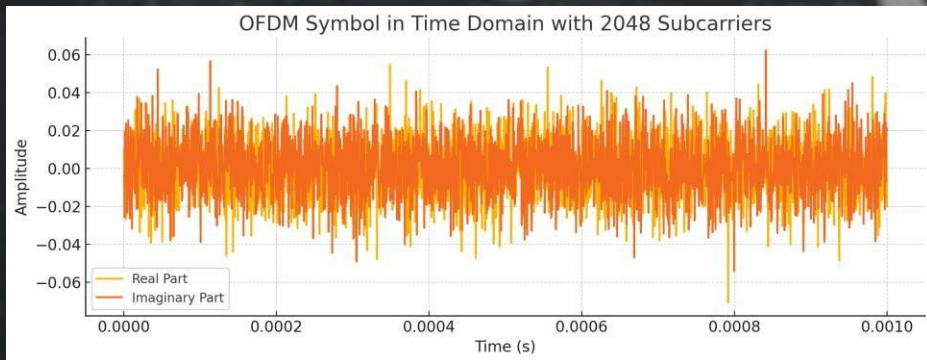


Valencia, 2019

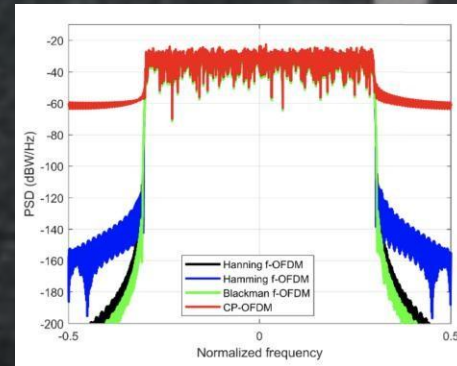
Why do we need a 6G Network?

- 5G-NR has improved the RAN flexibility, but still based on OFDM.

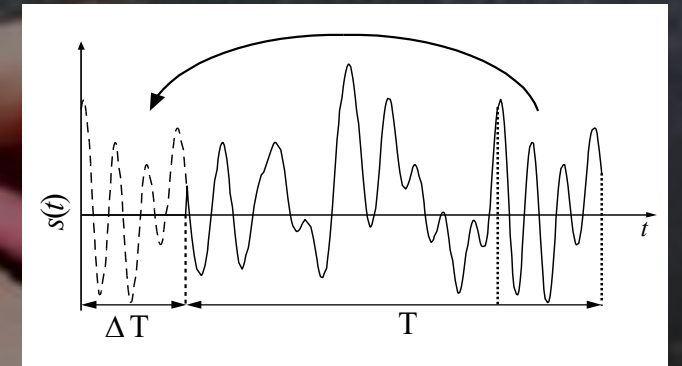
Why?



High PAPR



High ACLR



Short CP

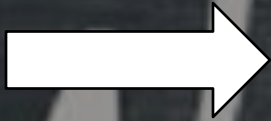
Why do we need a 6G Network?

- Odd generations innovate, even generations deliver!



1G

Personal communications



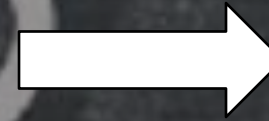
2G

Mass adoption of mobile services



3G

Internet Access



4G

Full broadband access experience



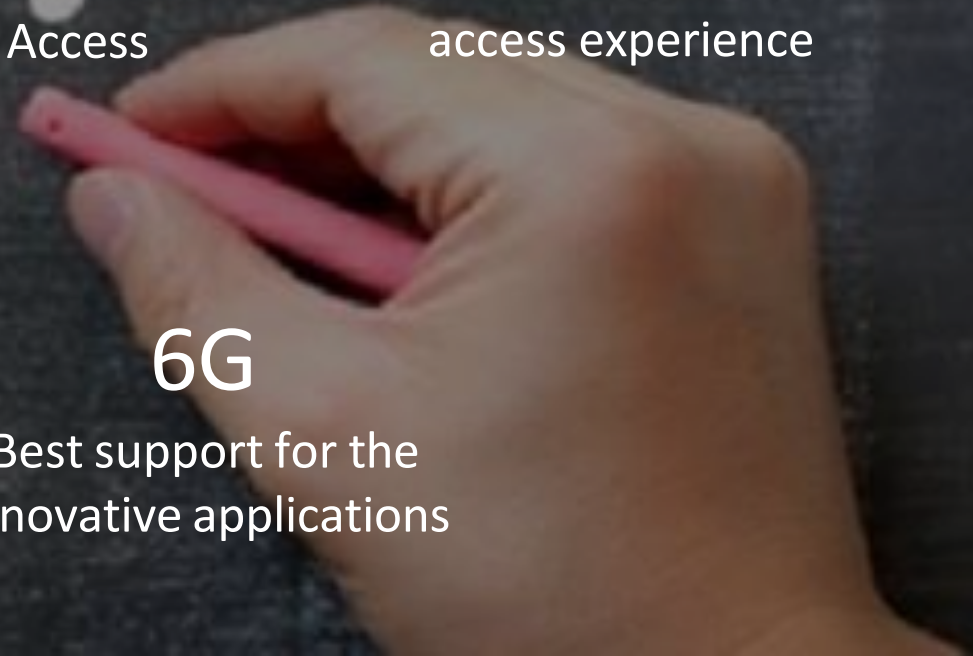
5G

New services exploiting the innovative operation modes



6G

Best support for the innovative applications



What else will 6G bring?



Communication



Sensing
Imaging
Positioning
Artificial Intelligence

6G will not be just a communication network

Important verticals for Brazil



Smart farming and mining



Digital Twins



Health care



Education



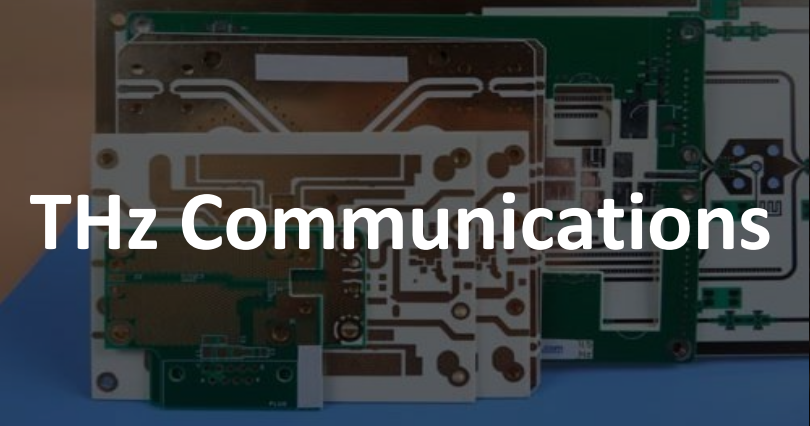
Transport and Logistics



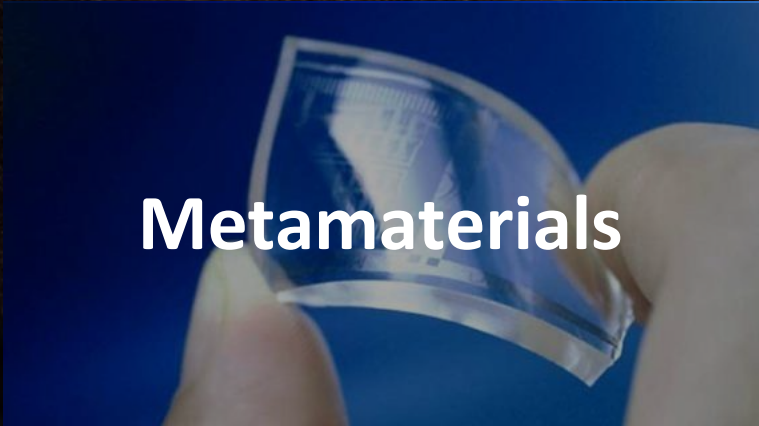
Smart cities

Requirement	Value
Peak Capacity	>500 Gbps
User data rate	Up to 100 Gbps
Latency	< 1 ms
Outage Probability	10^{-7} - 10^{-9}
Spectrum efficiency	10 x 5G
IoT Battery lifespan	Up to 20 years
Number of slices	10.000
Device density	$100/\text{m}^3$ or $10^5/\text{km}^2$
Spatial precision	1 cm to 100 cm

Some enabling technologies



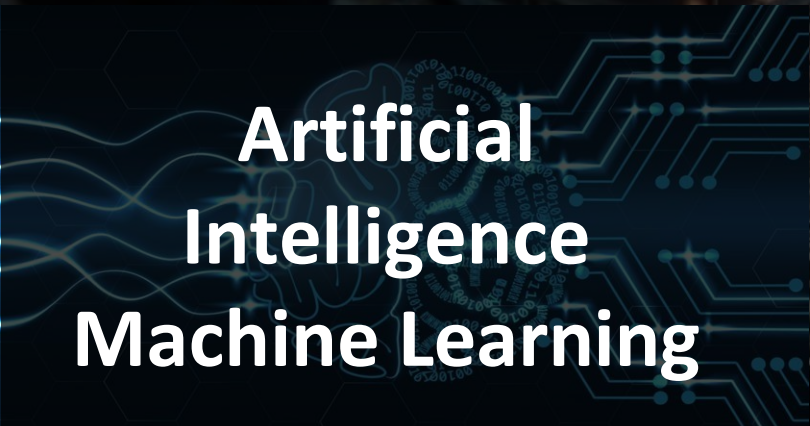
THz Communications



Metamaterials



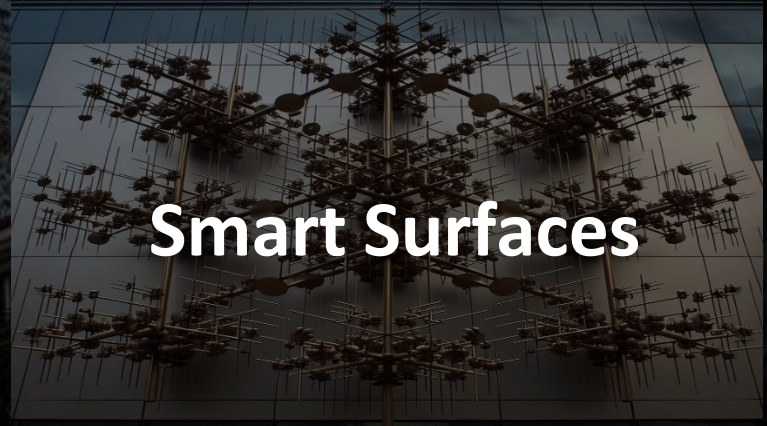
New Waveforms



**Artificial
Intelligence
Machine Learning**

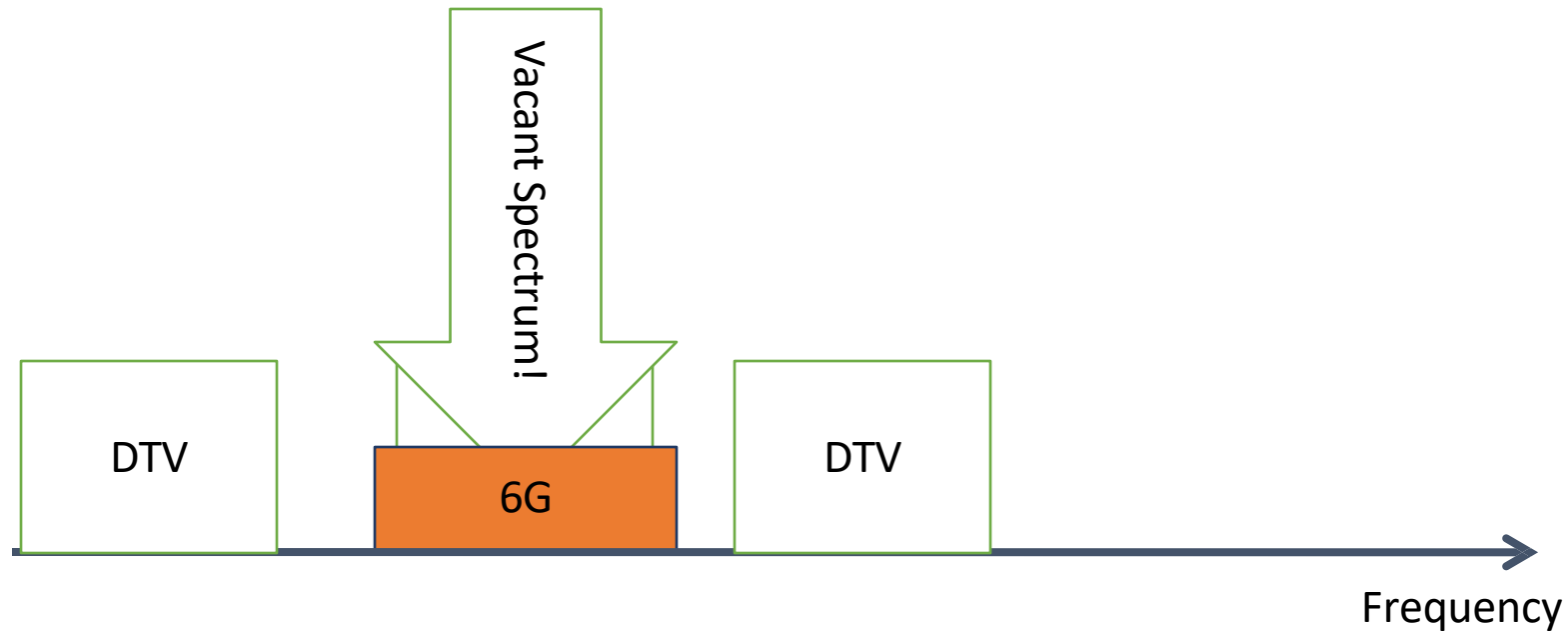


**New Spectrum
Allocation**



Smart Surfaces

How spectrum sensing can be useful?



The below 1 GHz is too good to be left empty in rural and remote areas!

Several user cases can be supported by an unlicensed 6G over TVWS!

Coexistence is possible with the right technology

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- Formas de onda:
GFDM, OFDM e F-OFDM

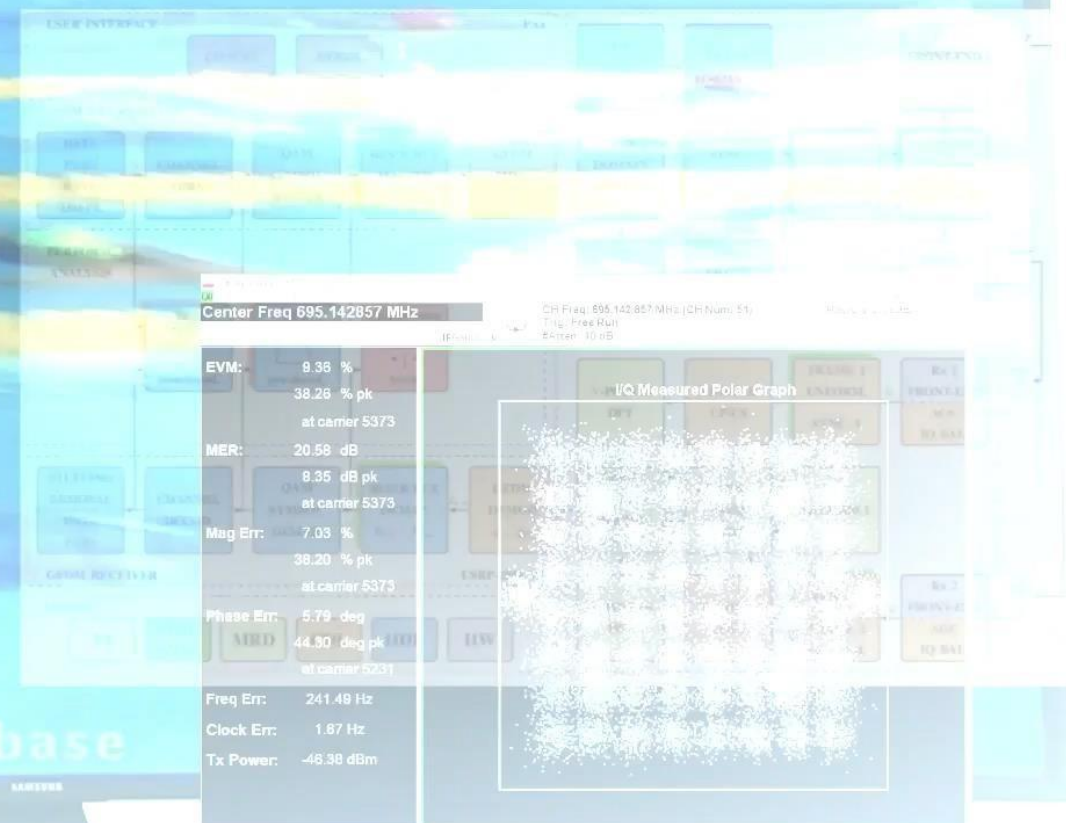
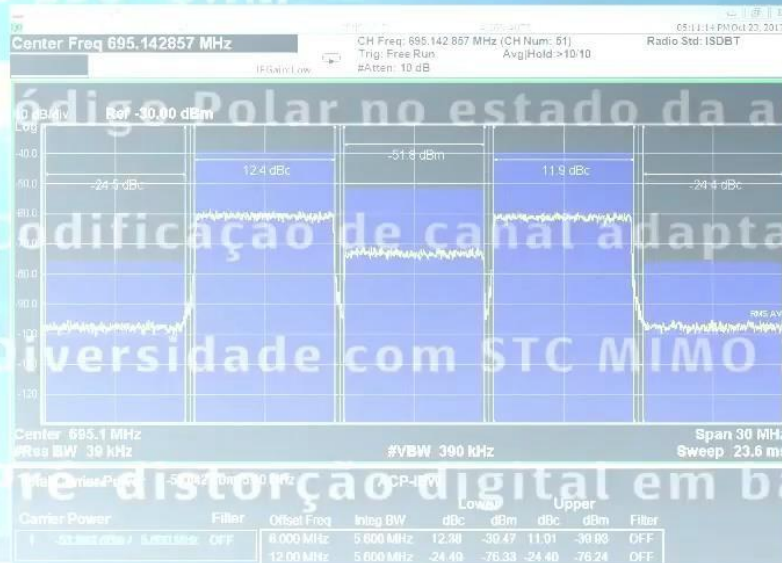
- Modulações:
16-QAM, 64-QAM
e 256-QAM

- Código Polar no estado da arte

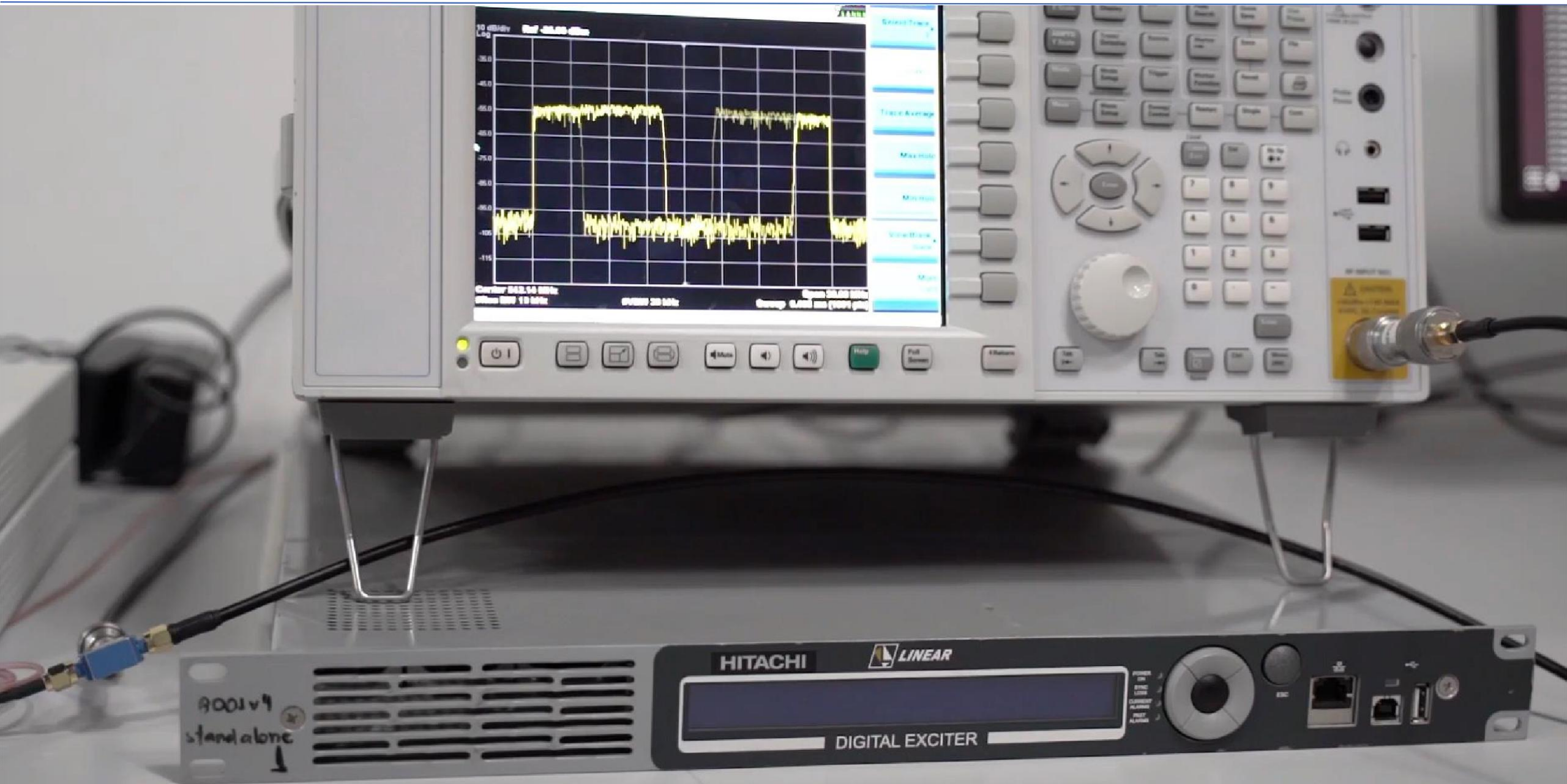
- Codificação de canal adaptativa

- Diversidade com STC MIMO 2x2

- Pre-distorção digital em banda base



Sensing for dynamic and fragmented spectrum allocation



The 6G network cannot continue leaving a significant portion of the population without coverage.

The demands of strategic verticals must be supported by future networks.

Technology has evolved to enable new ways of using the spectrum.

Brazil has the potential to be a leader in the use of TVWS.

Obrigado!

<http://www.inatel.br/xgmobile>

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