

TVWS as a solution for unlicensed 6G Networks

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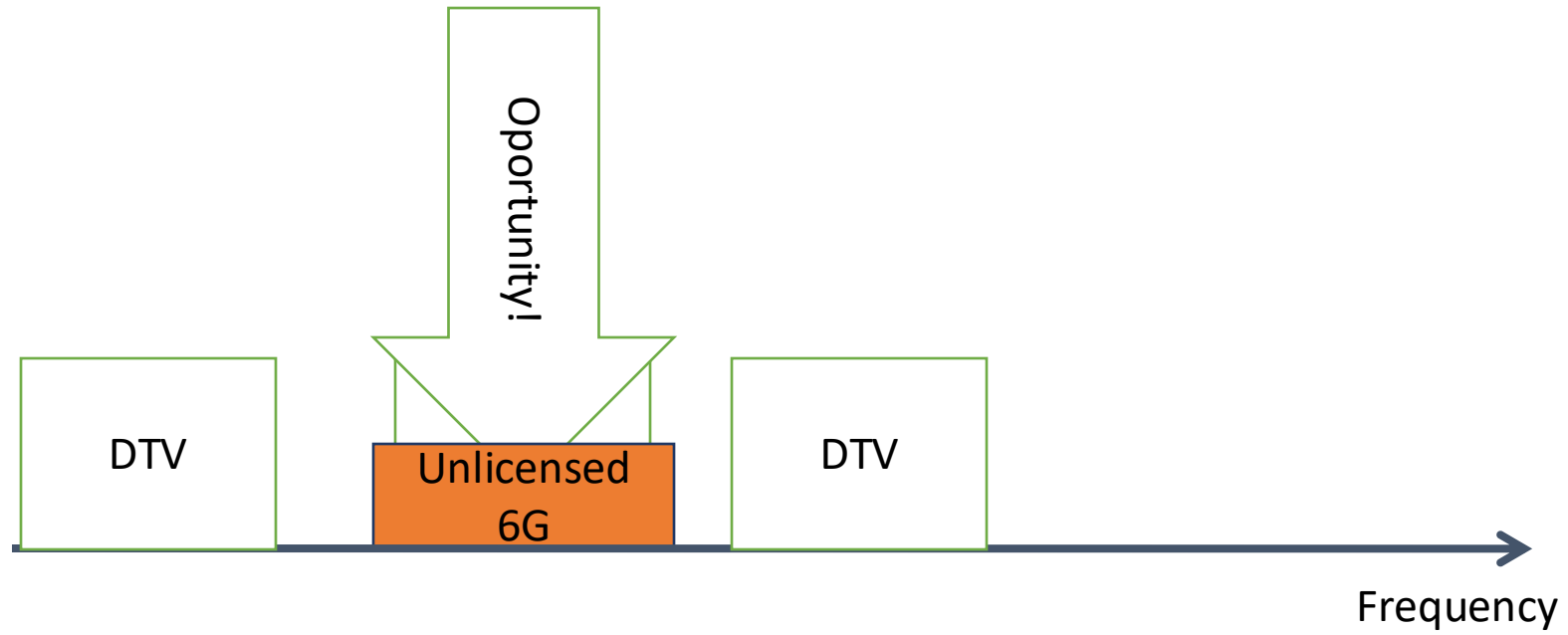
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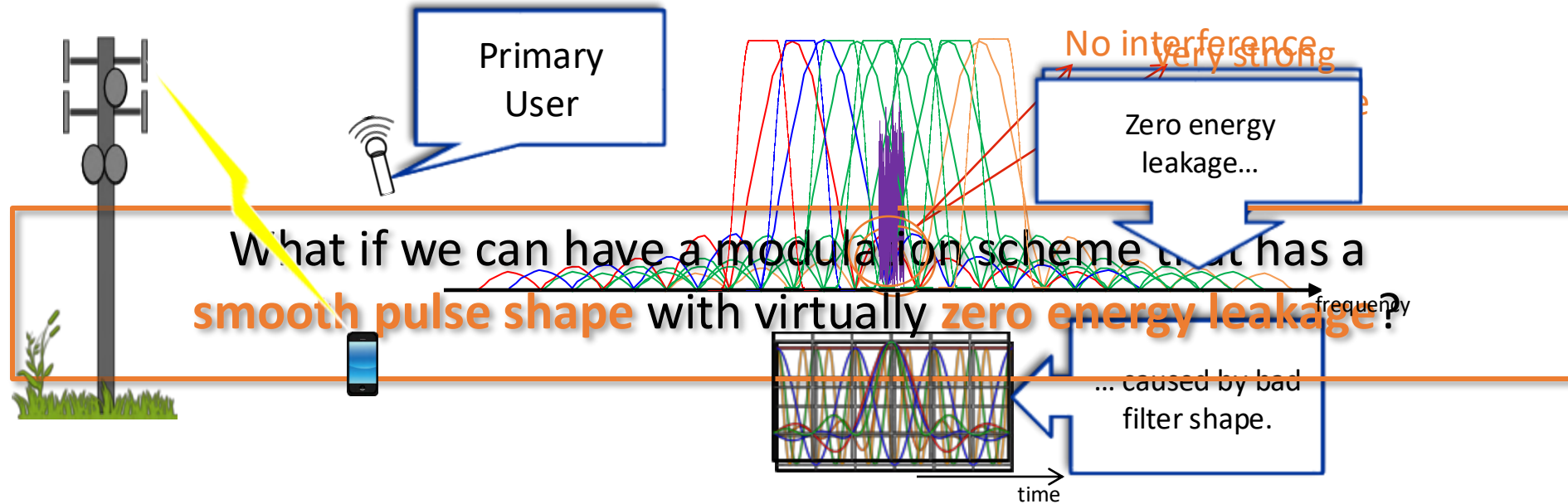
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How can we use the available VHF and UHF bands to provide the digital transformation for the strategic verticals in Brazil?





High energy leakage (Cognitive Radio)



The ability to **control the pulse-shape** allows the co-existence with other technologies.

Spectrum
Sensing
matters!



New technologies can solve these problems

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

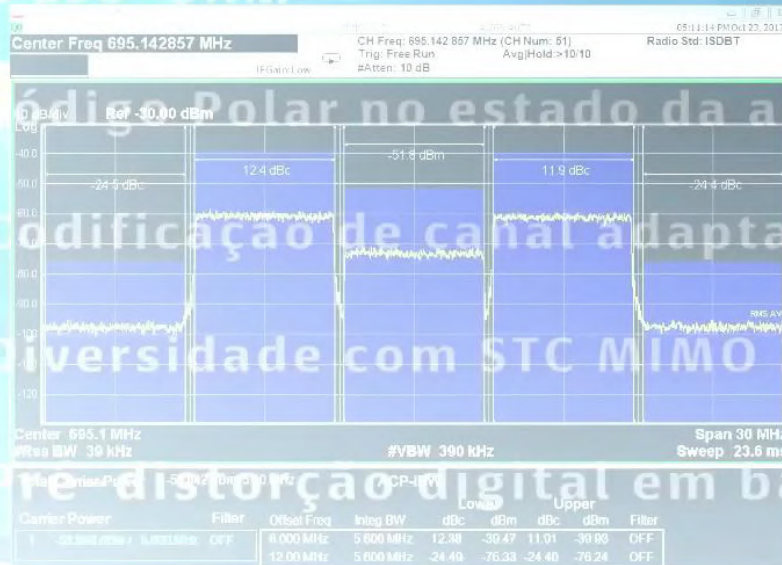
- Modulações:
16-QAM, 64-QAM, 256-QAM
e 256-QAM

- Código Polar no estado da arte

- Codificação de canal adaptativa

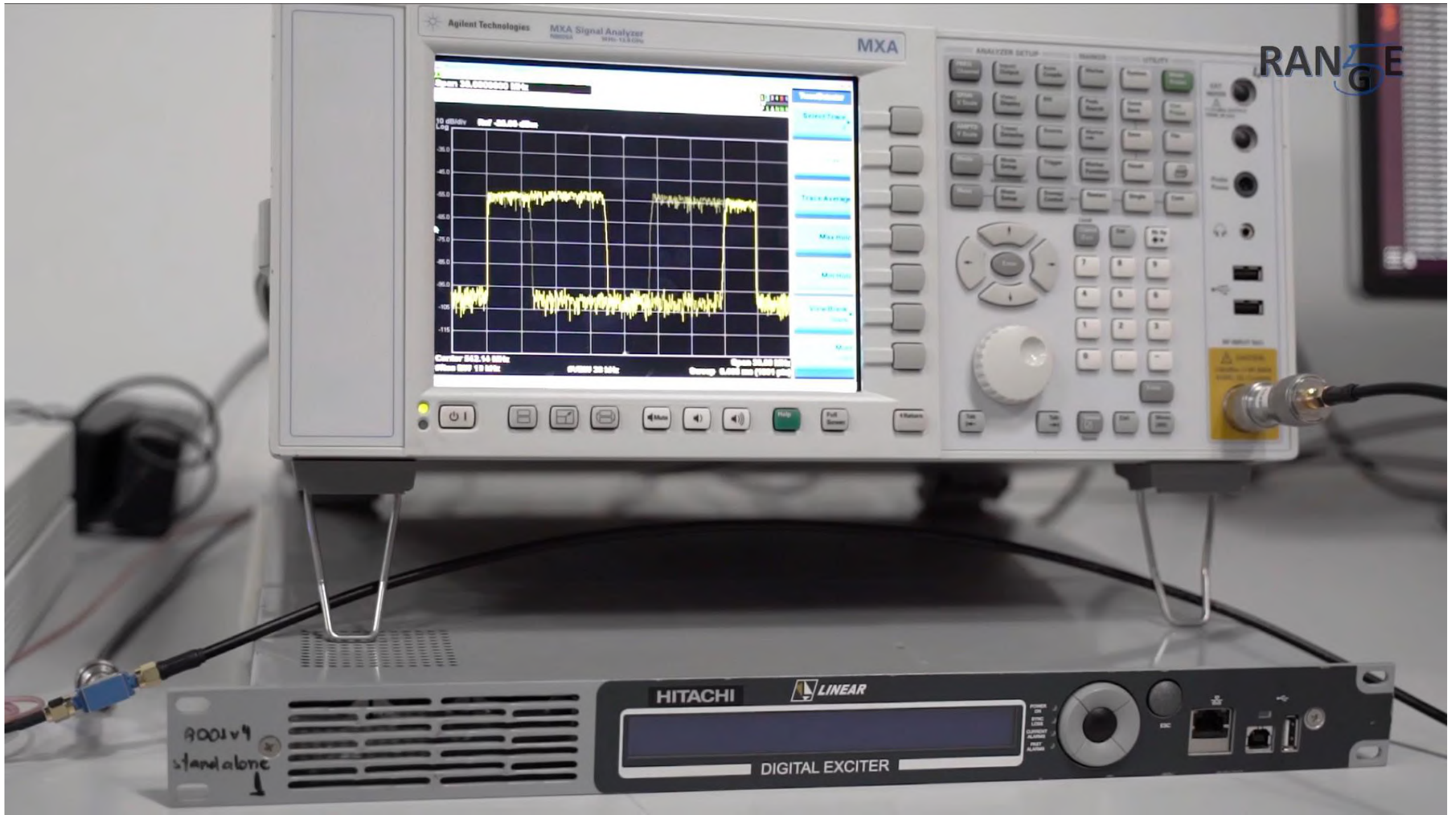
- Diversidade com STC MIMO 2x2

- Pre-distorção digital em banda base



Spectrum sensing for primary user protection

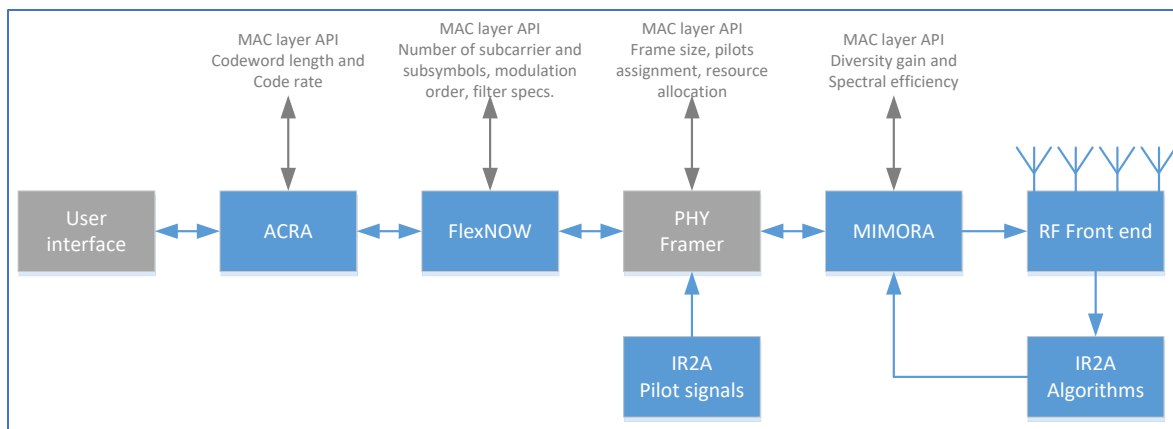
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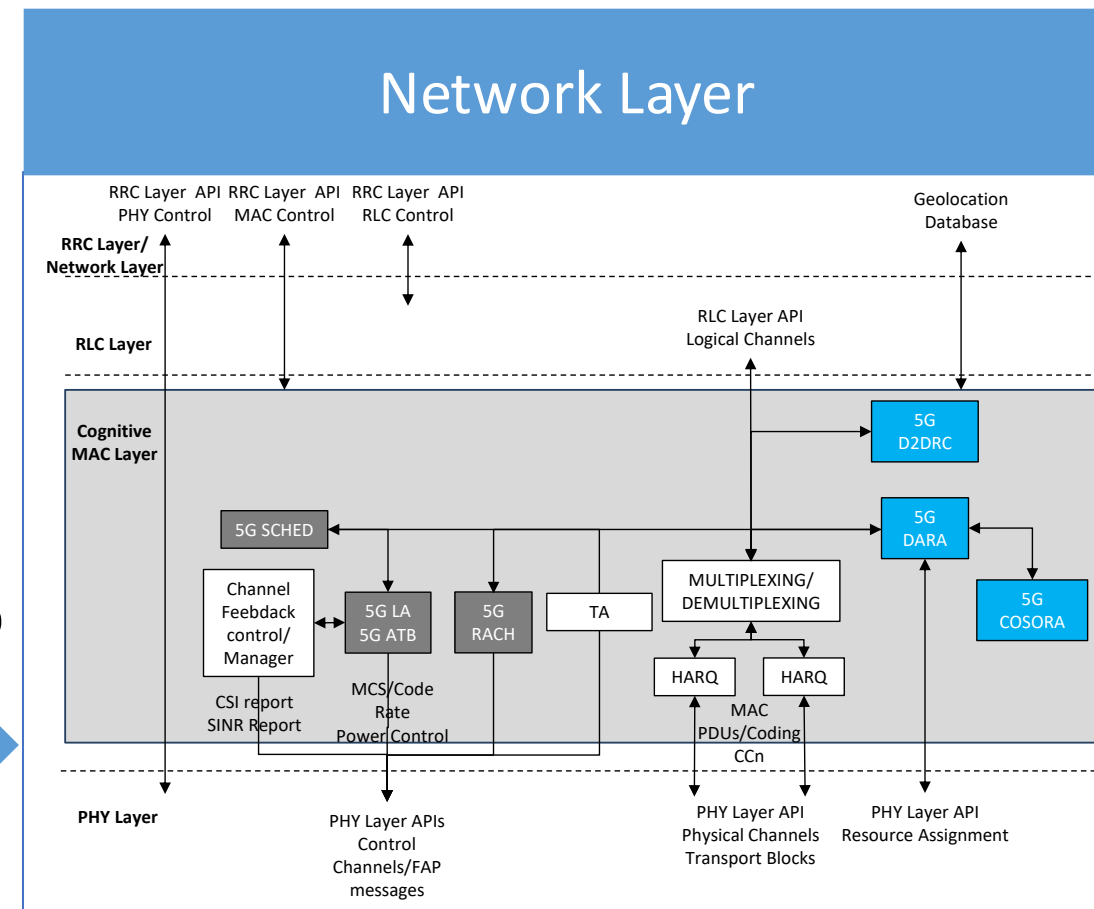
- Propose Radio Access Network

- Powerful coding scheme
- MIMO for diversity and multiplexing
- Narrow subcarriers – robustness against multipath

Flexible PHY



Cognitive MAC



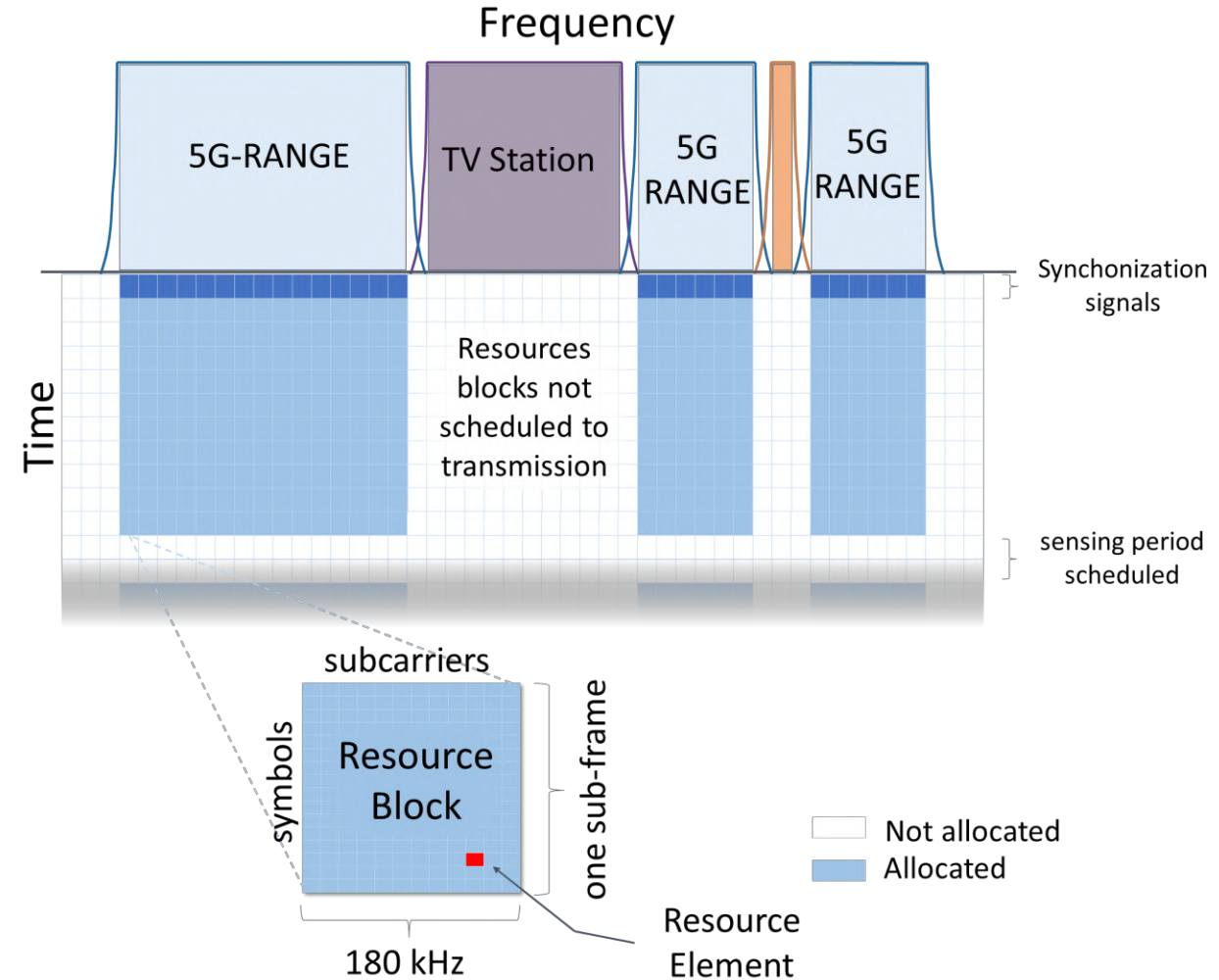
- **Flexible frame structure & Numerology**

- Idea

- Use low OOB waveform to allow coexistence in TVWS bands.
 - Use different numerology address conflicting requirements.

- Approach

- TVWS primary user protection implemented using blank resources on the grid.
 - Silence period to allow spectrum sensing.
 - Resource grid designed to allow multiple numerology to coexist in different subframes.
 - Dynamic selection of the numerology, on a subframe basis, according to user mobility and actual channel state.



Conclusions

TVWS can fill the connectivity gap in Brazil.

The use of modern digital modulations enables coexistence even in adjacent channels.

Spectrum sensing is essential for harmonious coexistence between DTV and TVWS.