CELTIC-NEXT
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User Positioning for Enhanced Services &

Implementating Cellular RAN in RISC-V Platforms

U.PORTO
FEUP FACULDADE DE ENGENHARIA
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Some words about me

- **Pedro Santos, Assistant Professor** at Faculdade de Engenharia da Universidade do Porto (FEUP)
- Experience with Eureka projects (ITEA3 MIRAI project)
- **Looking for consortiums – I'll present two potential use-cases**

- **Instituto de Telecomunicações – Networks, Applications and Protocols (NAP) group**
  - Wide expertise on WiFi and cellular technologies

- **Faculty of Engineering (FEUP)** is the largest faculty of U.Porto, with about 8158 students and 978 teaching staff and researchers across 9 departments.
  Funding (2019 numbers):
  - In the **FP7**, FEUP was partner and/or coordinator in a total of **48 projects, two ERC Grants, and 3 Individual Marie Curies.**
  - In **Horizon 2020**, FEUP is **partner in 31 projects.**

User Positioning for Enhanced Services

User Positioning for Enhanced Services

- Asset tracking market is valued at USD 23.42 billion in 2024, projected to grow to USD 59.64 billion by 2032 [1]
- Improved knowledge of number and location of users allows targeted services
  - Count number of people in a museum
  - Present detailed information about artwork on display on user's smart phone
- How to inexpensively locate the user indoors?
  - **Already-in-place wireless infrastructure (WiFi or 5G) can be harnessed!**

1- Forbes Business Insights. "Asset Tracking Market Size, Share & Industry Analysis". Online; URL: https://www.fortunebusinessinsights.com/asset-tracking-market-109490 Consulted: 08/09/2025.

User Positioning for Enhanced Services

- Goal: **precisely locate users or assets in indoor (or outdoor) contexts using WiFi or cellular**
- Some technologies:
  - **Channel Sounding:** monitor Channel Impulse Response (CIR) in rest and when subject passes by (showcased with WiFi and OAI RAN [1])
  - **Angle-of-Arrival:** well-established; limited to multi-antenna setups.
  - **Time of Flight**: Fine Timing Measurements (FTM) already in use in WiFi (IEEE 802.11mc)
  - **Time Difference of Arrival:** showcased with OAI RAN [2]; requires tight synchronization between base-stations
- Challenges to tackle:
  - **Channel Uncertainty:** handling Line-of-Sight (LoS) and multipath → AI can help detecting and addressing such issues
  - **Value Proposition:** evaluate and improve systems' performance to match competitor solutions and cater to client SLAs
  - **Exploitation: How to market POSITIONING SERVICES through the 5G system and WiFi infrastructure?**

[1] OAIBOX. "**Integrated Sensing and Communication (ISAC) with OAIBOX"**. Online; URL: https://www.youtube.com/watch?v=bkqMERFcnQM Consulted: 08/09/2024.
[2] MALIK, Adeel, et al. "**From concept to reality: 5G positioning with open-source implementation of UL-TDoA in OpenAirInterface"**. *arXiv preprint arXiv:2409.05217*, 2024.

Implementating Cellular RAN in RISC-V Platforms

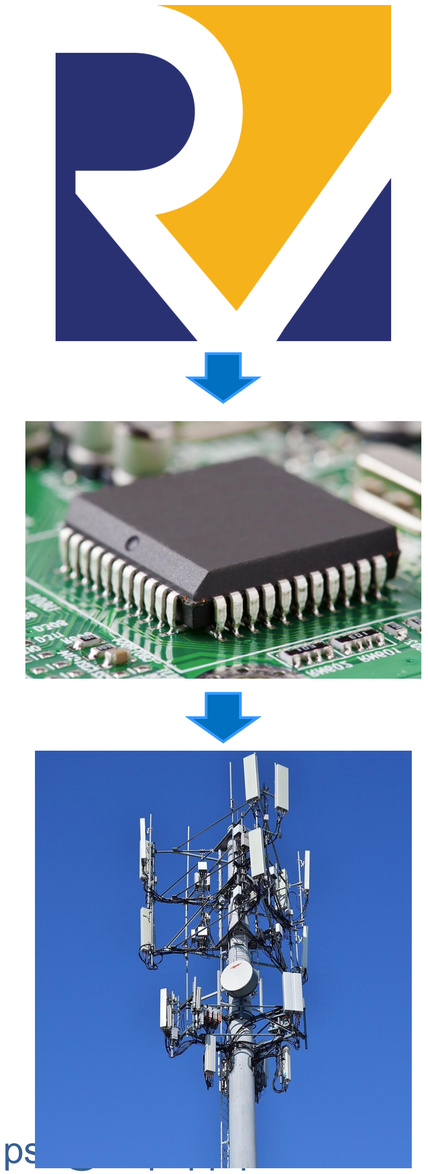
Cellular RAN in RISC-V

RISC-V:

- RISC-V is an instruction set architecture (ISA) that is free to use and implement, unlike ARM or x86.
- Projected to grow to over 16 billion chips by 2030[1].
- **This opens up the market to new players** that can design and market new General Processing (GP) and Application Specific (AS) processors.

Cellular RAN:

- The **5G Radio Access Layer (RAN)** relies on heavy computations, for which softwarization / virtualization not always meets requirements.
- **Most RAN solutions remain tied to ARM and x86**. This applies at least to two open-source RANs, *OAI RAN* and *srsRAN*.



1- Technosports. "**RISC-V: Projected Growth to Over 16 Billion Chips by 2030**".
Online; URL: https://technosports.co.in/risc-v-projected-growth-over-16-bn-chips-2030/ Consulted: 08/09/2025

Cellular RAN in RISC-V

- Two-levels of integration of RISC-V platforms for 5G RAN:
  - **Dedicated hardware**
    - Design programmable hardware co-processors using the RISC-V ISA
    - Advantages: future-proof – a programmable environment means ability to be updated for new 6G/xG algorithms/protocols without having to replace hardware
  - **Software-based approaches**
    - Typically customized to make the best out of x86, ARM architectures
    - **Question: performance in RISC-V devices? And *ENERGY-WISE*?**

Looking for

- Looking to integrate a consortium with one (or both) use-cases

- Looking for national partners
  - **Industrial entities operating WiFi & 5G systems**
  - **Industrial entities developing platforms to run 5G systems (& interested in RISC-V)**
  - **Service providers interested in exploring user (or asset) positioning**

Contact Info

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Presentation is available via: