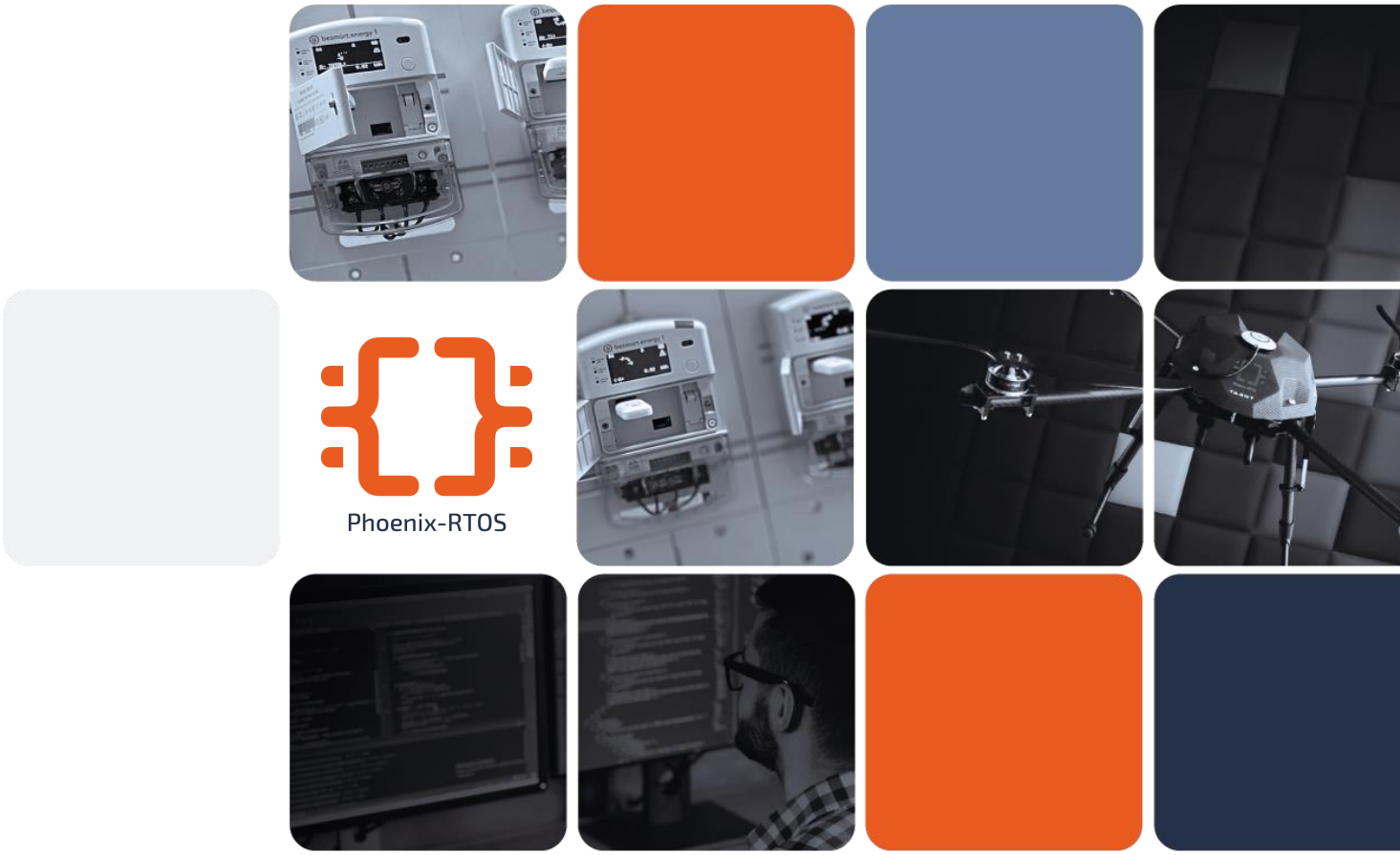
Phoenix Systems

developer of Phoenix-RTOS



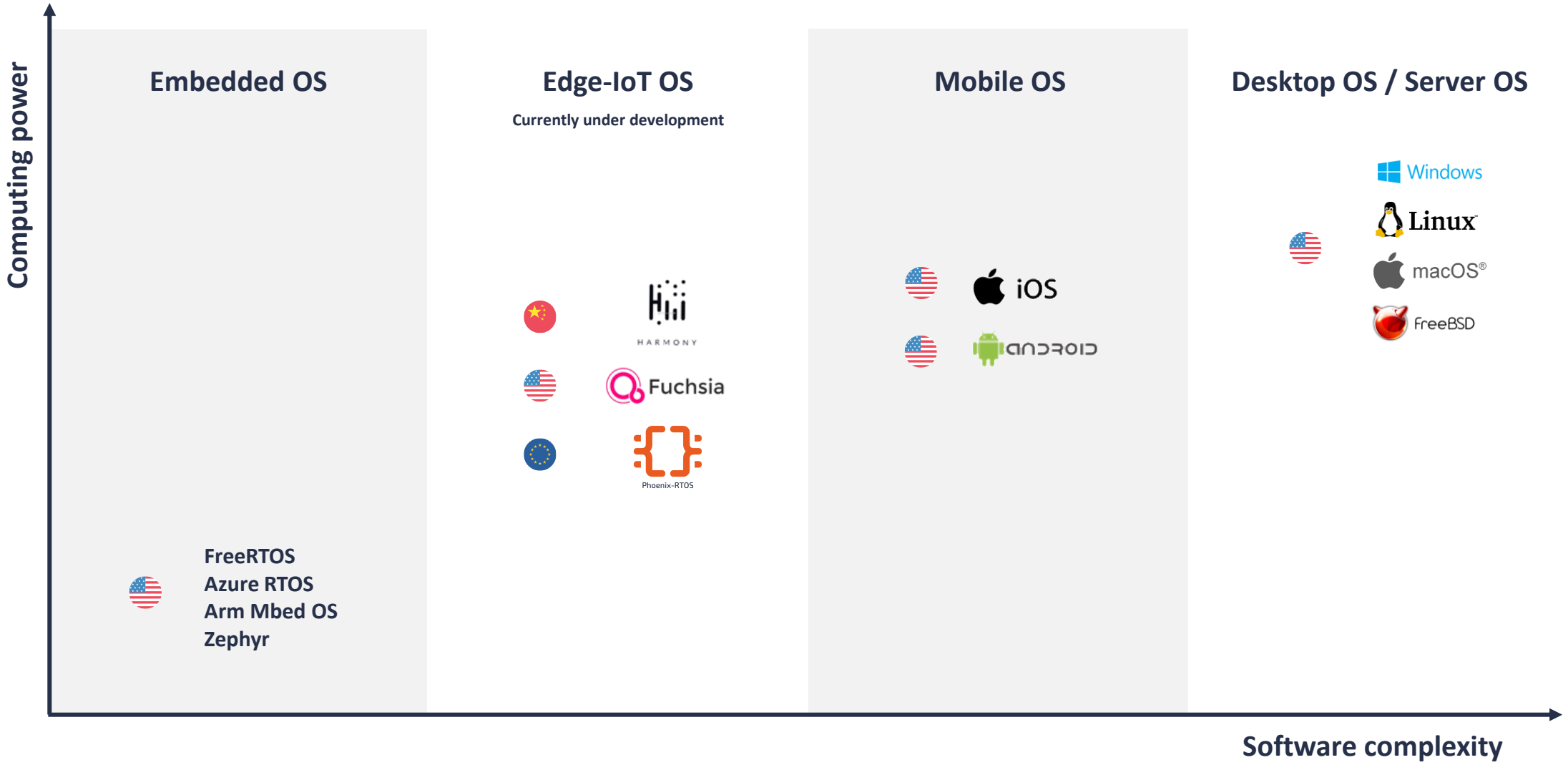
Phoenix-RTOS

an open-source, microkernel-based, operating system for Edge-IoT

Phoenix-RTOS

- Phoenix-RTOS is an open-source, real-time operating system with a **highly-scalable, microkernel-based** architecture.
- Its source code is available under BSD license on GitHub: **github.com/phoenix-rtos**.
- Phoenix-RTOS is being developed since 1999, with its prototype created at the Warsaw University of Technology. The current version is based on a microkernel written from scratch.

Market analysis



Market demand

The European market lacks an operating system that orchestrates far-edge and eases software development for Edge-IoT devices.

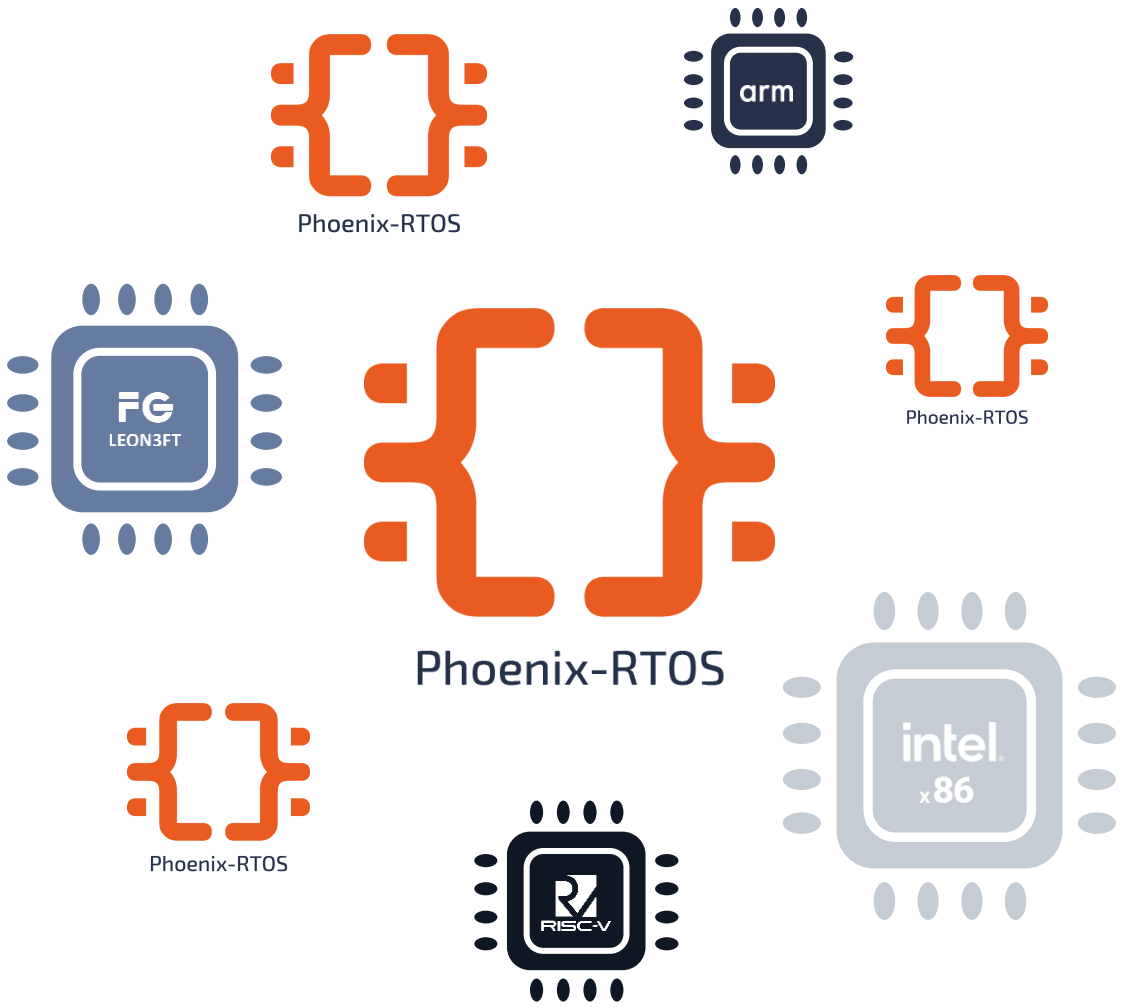
Why is there a technology gap?

- **General purpose operating systems** (e.g., GNU, Linux) are developed mainly to run advanced applications and effectively share computing resources, but due to their complexity they **are not intended for Edge-IoT devices**, based on resource-constrained hardware.

- **Simple exo-kernels** (e.g., FreeRTOS, RTEMS) for embedded applications simplify the bare-metal software development, but **do not offer operating system's functionality**, especially advanced application environment enabling execution of external user applications.

Phoenix-RTOS characteristics (1)

- The main purpose of the Phoenix-RTOS operating system is to provide a functionally-extensive application environment compatible with well-known interfaces: POSIX, APEX.
- Phoenix-RTOS supports kernel and user space separation and multiple address spaces (either using MMU or MPU).
- Resource partitioning enabling execution of multiple critical applications on a single device without virtualization technique is currently under development.



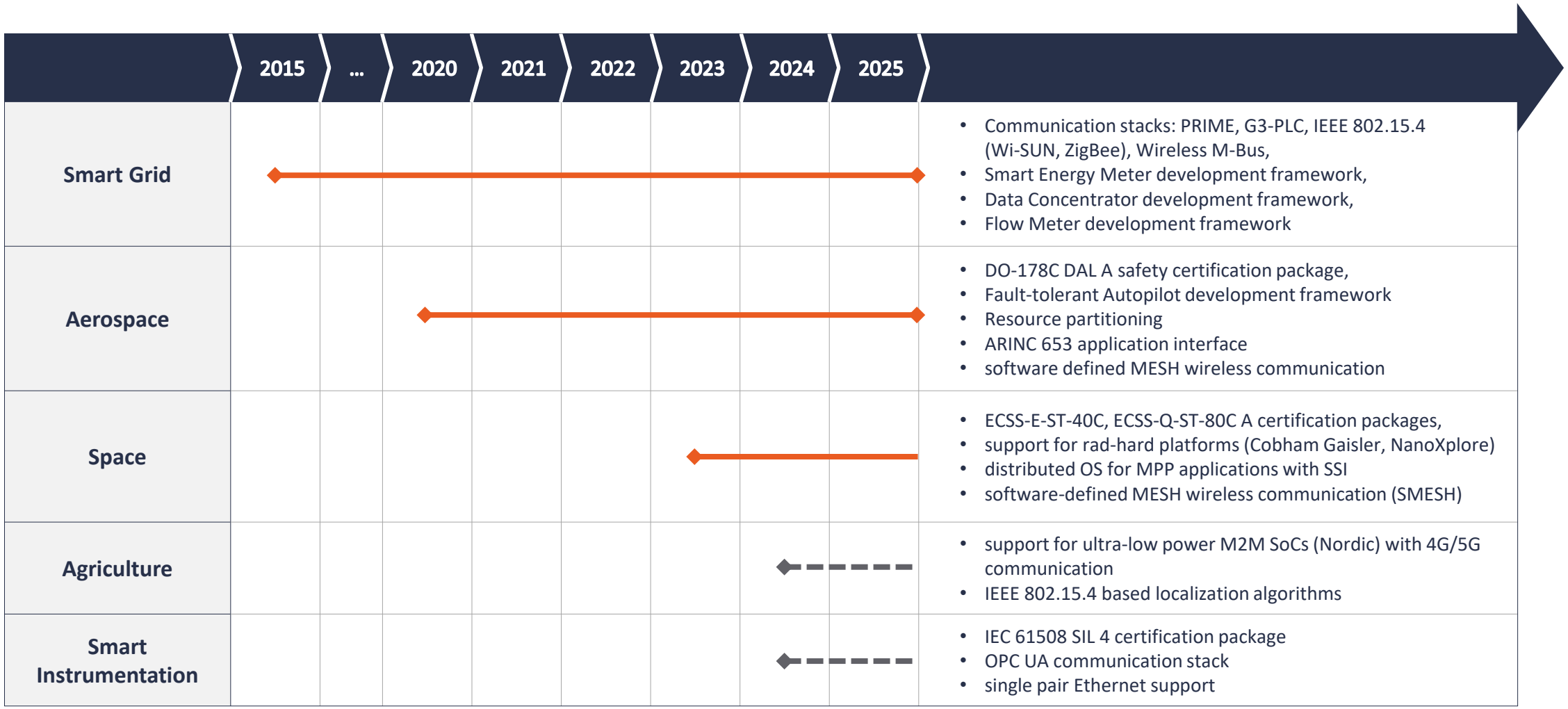
Phoenix-RTOS characteristics (2)

- Phoenix-RTOS offers full support for a whole range of processor architectures: ARM, RISC-V, LEON3FT, x86.
- It enables the execution of user edge applications on multiple types of hardware platforms, from resource constrained microcontrollers to massively parallel multi-processors.

Market sectors

- Phoenix-RTOS has already been massively deployed in Smart Grid sector (1.1M smart metering devices: energy meters, gas meters, data concentrator units)
- Phoenix-RTOS is now expanding to other industry sectors - aerospace and space.
- Certification packages and support for development methodologies compliant with Software Safety Assurance standards (DO-178C, ECSS standards) are currently under development.

Phoenix-RTOS roadmap

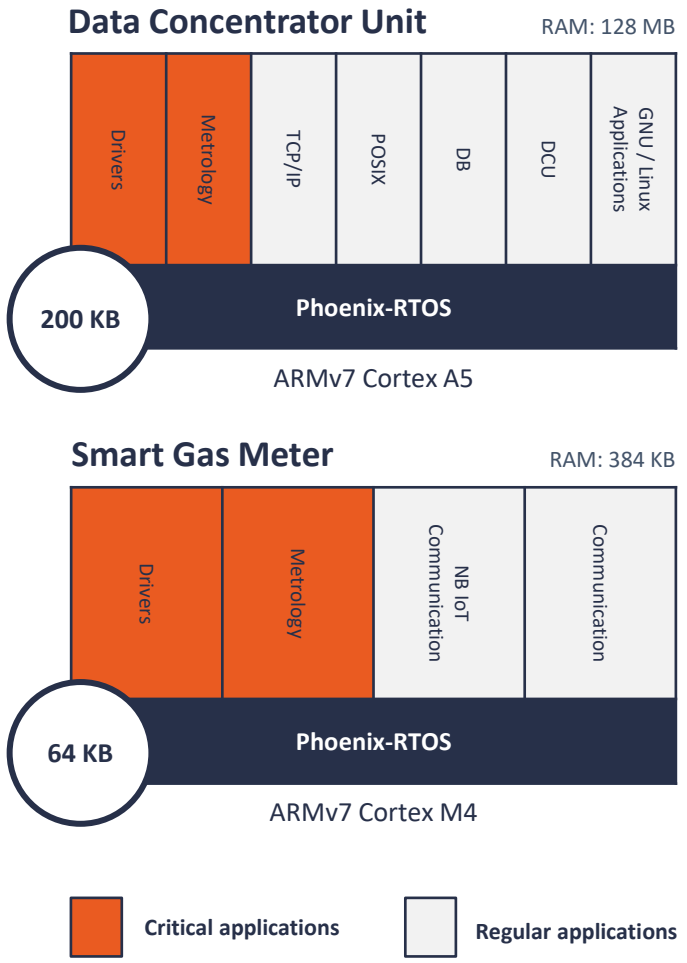


Smart Grid deployments (1)

Data Concentrator Unit - **40K devices** for Energa-Operator S.A., gather data from 2M smart meters in power grid (the largest implementation in Poland). Devices with TCP/IP communication and several security protocols used (IPSEC, 802.1X, TLS), support PRIME 1.3.6, PRIME 1.4 PLC standards.

iSmart1 Gas Meter - **16K devices** for PSG (Poland). Smart gas meters with GSM (2G) communication. With optimized resource usage the device battery lifetime is over 10 years.

iSmart2 Gas Meter - **1M devices** for the Belgian market (Fluvius System Operator CV), using Wireless M-Bus, NB IoT communication and OMS protocol. With optimized resource usage the device battery lifetime is over 15 years.



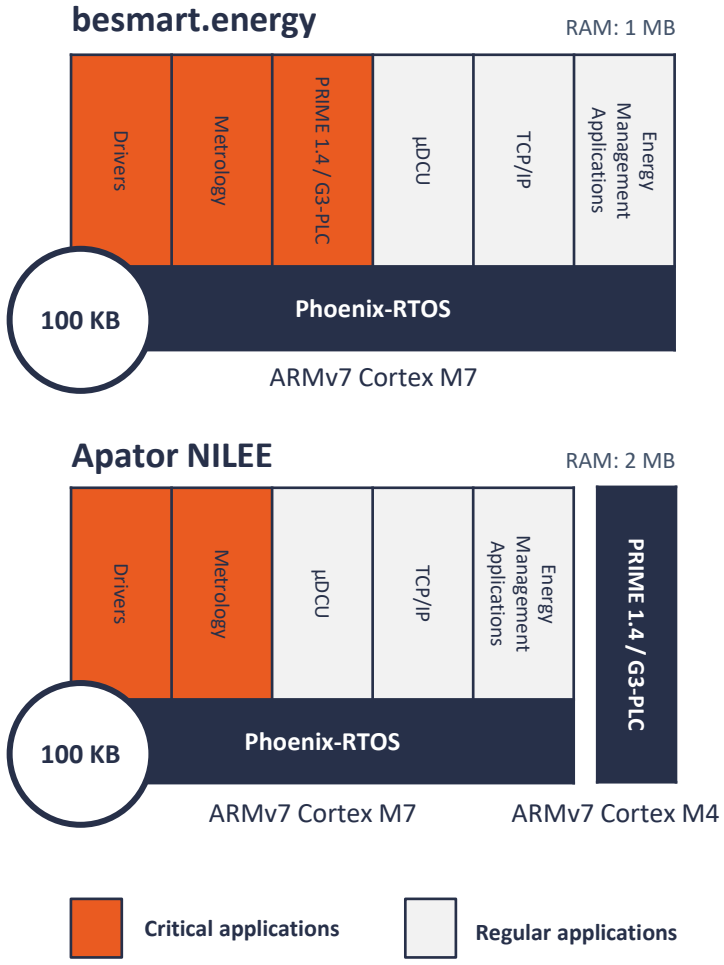
Smart Grid deployments (2)

besmart.energy Smart Energy Meter – 1-phase and 3-phase meters with **energy management** functionality (realised by additional user Edge applications), rich connectivity (PRIME 1.3.6, PRIME 1.4, G3-PLC standards, LTE, Wi-Fi), USB stack and optional PLC data concentrator function.

Prototype with open-hardware license.

Apator NILEE Smart Energy Meter – 1-phase and 3-phase meters with **energy management** functionality (realised by additional user Edge applications), rich connectivity (PRIME 1.3.6, PRIME 1.4, G3-PLC standards, LTE, Wi-Fi), USB stack and optional PLC data concentrator function.

Meter adapted for mass production and deployment.



Aerospace

Phoenix Systems is currently carrying out an EU co-funded R&D project, Phoenix-RTOS 178, to be finished in the fall of 2023.

The goal of the project is to develop a certification package for a microkernel (for Xilinx Zynq SoC), compliant with the guidelines of the DO-178C safety standard, meeting the new EU / EASA safety requirements and enabling the application of Phoenix-RTOS in next-generation UAVs.

Other ventures:

- Development of an open-source fault-tolerant (triplicated) autopilot – **Phoenix-PILOT**.
- Development of a software-defined wireless communication system (for 2.4 GHz).

Space

Phoenix-RTOS has been ported to LEON3FT (Cobham Gaisler GR716) rad-hard processor for deep space applications (e.g., CubeSats).

Under development:

- The Phoenix-RTOS qualification data packages compliant with European Space Standards (ECSS-E-ST-40C and ECSS-Q-ST-80C) for space applications.
- The Phoenix-RTOS distributed operating system for use in active, beamforming, metasurface antennas with Massively Parallel Processing (MPP) architecture - NanoXplore port.
- Software-defined Space MESH (SMESH) radio communication systems.

Development in line with ESA's strategic objectives, expecting the European-based R&D to develop and regain the European capacity to operate independently in space by minimizing outside-EU dependence.

Phoenix Systems

developer of Phoenix-RTOS

Phoenix Systems is a European high-tech company with over 10 years of experience, that develops its core product – **Phoenix-RTOS** – an open-source, real-time operating system for Edge-IoT.

It employs **over thirty talented**, highly-qualified software engineers focused on both innovative products' development and R&D activities.

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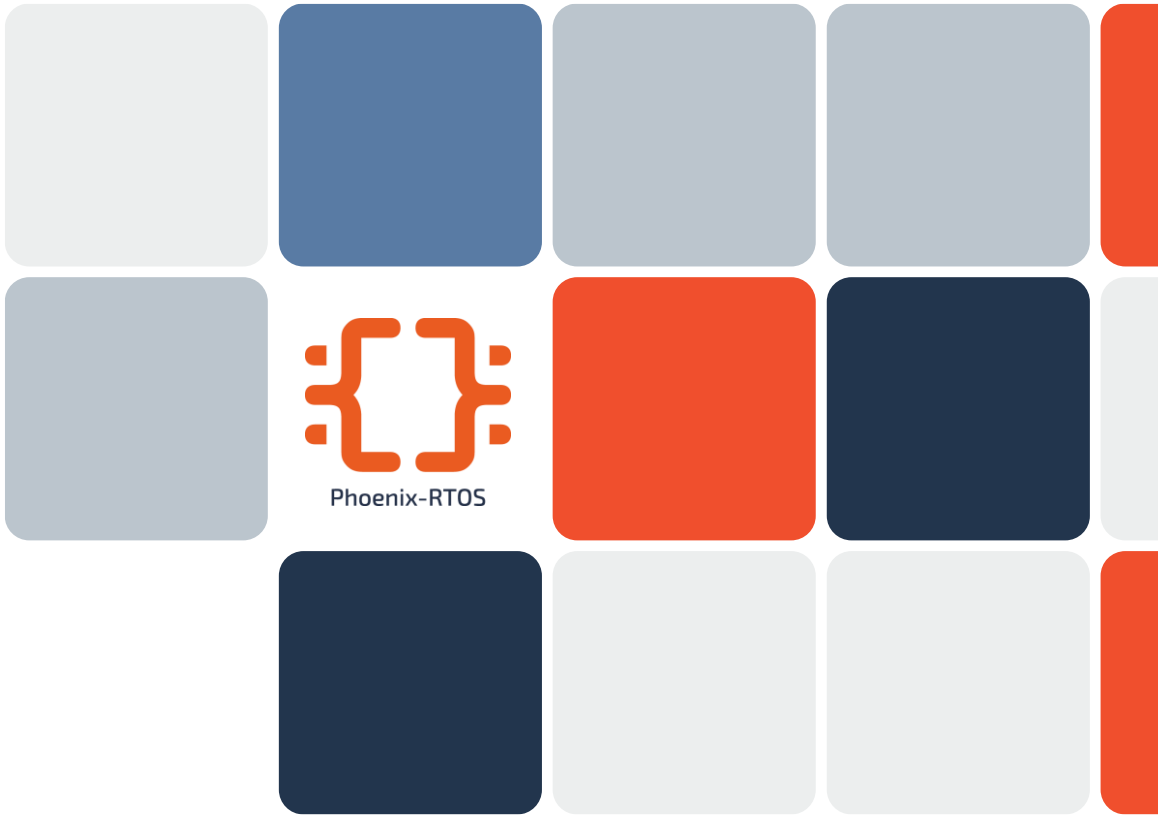

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