Phoenix-RTOS operating system

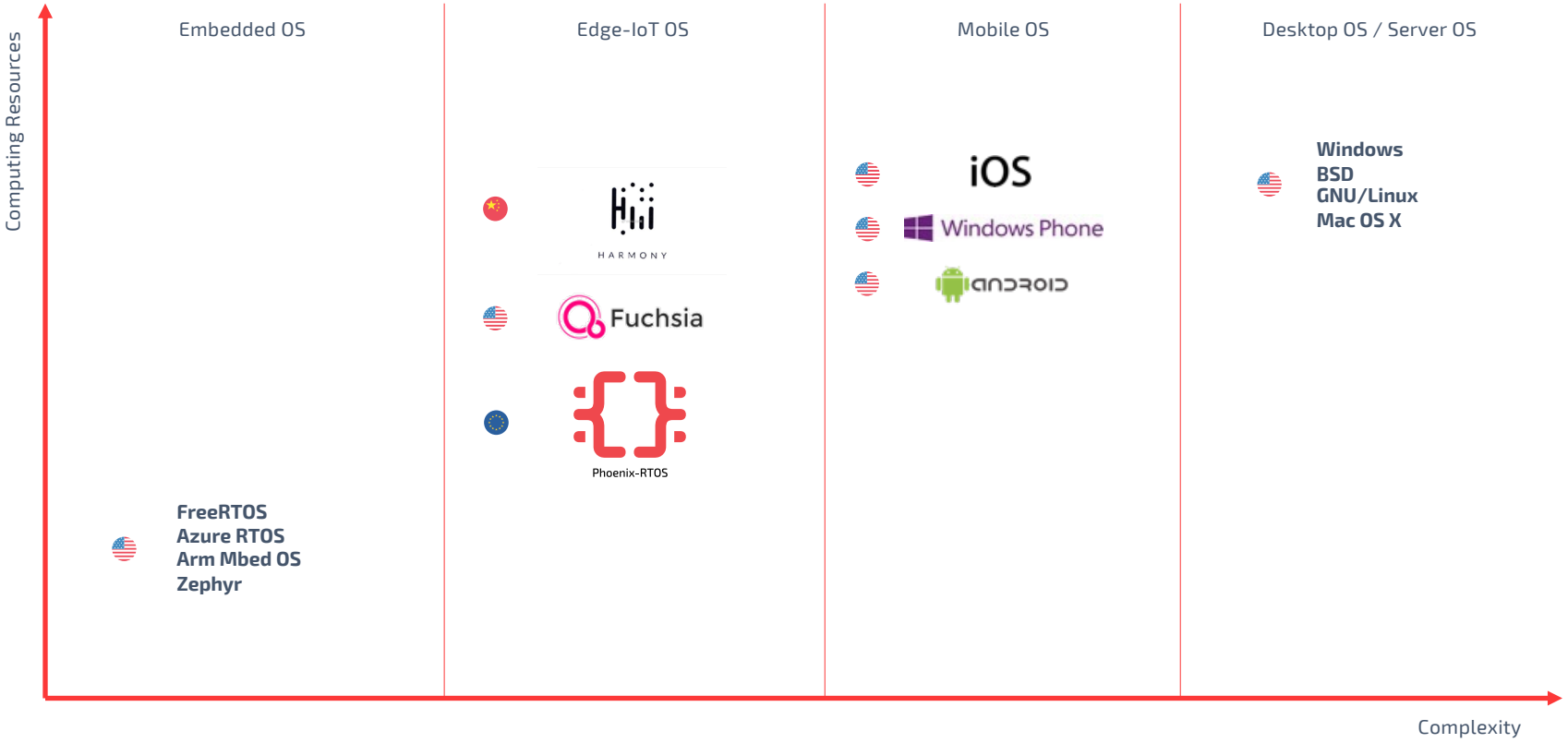
the foundation for Distributed Multi Provider Cloud-Edge-IoT Continuum

The IPCEI-CIS project presentation

ATENDE INDUSTRIES

Phoenix Systems

Edge-IoT OS market landscape



Exo-kernel and operating system in IoT

- After initial attempts to create IoT devices as simple sensors with a bare-metal software architecture, it was understood that this path did not lead to the creation of intelligent devices

- Exo-kernel (e.g. FreeRTOS, Azure RTOS) is a library linked to the user application that provides basic primitives such as interrupt handling, memory management, task scheduling, network stack, USB stack, simple file systems

- The operating system allows to run processes, threads, advanced memory management, including its effective sharing, provides the application environment (e.g. POSIX), the ability to run multiple applications, program separation and user interface

- Exo-kernel is 10-15% of the functionality of the operating system

- The greatest difficulty in implementing the operating system for Edge-IoT is scalability

- It is necessary to enable edge processing directly on the devices and to scale the functionality of devices by installing user applications in the so called Cloud-Edge-IoT Continuum

Phoenix-RTOS

Phoenix-RTOS

- Phoenix-RTOS is an open-source scalable real-time operating system for Edge-IoT applications
- Microkernel architecture, compact, scalable from battery operated to complex, multi-core IoT devices
- Advanced resources partitioning enables Phoenix-RTOS based appliance to run multiple (critical) applications on a single device
- Candidate for the global IoT standard **(implemented in 1.1M smart meters**)
- **Open-source available under BSD license** (github.com/phoenix-rtos/)
- Supplemented with communication stacks (Phoenix-PRIME, Phoenix-G3, Phoenix-802.15.4, Phoenix-WMBUS) and application frameworks (Phoenix-DCU, Phoenix-SEM)

EE Times Connecting the Global Electronics Community

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News & Analysis

IoT Woos Wedding of SoC & RTOS

Junko Yoshida

5/23/2018 00:01 AM EDT

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Phoenix-RTOS goes on GitHub

MADISON, Wis. — Get ready for the emerging battle over the IoT OS.

The market already features a host of real-time operating systems positioned as ideal or "optimized" for the Internet of Things. But the latest wrinkle is a growing demand among IoT SoC designers looking for a "bendable" RTOS. They want to design a proprietary IoT device architecture tightly married to a specific microkernel that they can modify, its framework and communication stacks.

Silicon Labs is among the first IoT SoC vendors to openly discuss this. Its 2016 acquisition of Micrium, a supplier of RTOS software, has allowed the Austin, Texas-based company to "bend the kernel of Micrium RTOS for connected IoT applications," Daniel Cooley, senior vice president and general manager of Silicon Labs' Internet of Things (IoT) products, explained to EE Times last year.

Rob Oshana, vice president of software R&D at NXP Semiconductors confirmed a similar trend on the IoT market. He told us, "Yes, next-generation IoT devices are now being designed from the ground-up jointly by software developers, system architects and microcontroller design."

He noted, "Software teams drive the programming models, which are an abstraction from the underlying compute algorithms and data structures. This helps bridge the gap between supporting layers of application software and the underlying hardware architecture."

He explained, "This includes the RTOS requirements that can be improved with hardware implementation such as low-level interrupts, memory management, and clock support." Oshana added, "For connected applications, software teams provide PHY and MAC level stacks that are architected closely with hardware design teams for efficient SoC design."

In sum, IoT chip vendors say they need an RTOS they can customize to their specific needs. The question is who can offer such a flexible and scalable RTOS.

Fully cognizant of this new trend, a Warsaw, Poland company, Phoenix Systems, last week made available the source code of the company's Phoenix-RTOS on GitHub.

Pawel Pisarczyk, Phoenix Systems' president and CEO and the author of Phoenix-RTOS, told EE Times that he released the RTOS to the open-source community because "I see the value [we can offer] is not so much in the operating system itself, but instead, in our ability to provide frameworks, libraries and support for the IoT community."

The BSD license — under which Phoenix-RTOS has been made available — "focuses on user rights and allows for source code modifications," Pisarczyk explained.

Pawel Pisarczyk

"Just like Android — a free OS — has helped build a host of smartphone applications Android community, we applications," Pisarczyk

Heritage of Phoenix-R

Chris Rommel, executiv observed, "Branding an RTOS are used in syste

特集 エッジコンピューティングの逆襲 現場で回すデータ活用がもたらすもの

リアルタイムOS列伝（12）

スマートメーターに特化したポーランド発RTOS「Phoenix-RTOS」の潔さ

（1/3 ページ）

2021年07月05日 10時00分 公開 [大原雄介，MONOist]

印刷する クリップする 通知する 12 Share B! 2

今回はポーランド発のリアルタイムOS（RTOS）である「Phoenix-RTOS」をご紹介したい。開発元はPhoenix Systemsという会社だが、この会社が成立するまでのいきさつがなかなか複雑である。

⇒連載記事「リアルタイムOS列伝」バックナンバー

大学生による開発から、スクラッチで作り直された「Phoenix-RTOS 2.0」へ

このPhoenix-RTOSの開発者であるPawel Pisarczyk氏、もともとワルシャワ工科大でコンピュータサイエンスの学位を取る際の卒論のテーマがどうもPhoenix-RTOSの原型だったらしい。その後、そのままワルシャワ工科大で博士号まで取得するが、これと並行して2002年にはIMMOS（古い方にはおなじみのINMOSとは違うので注意）という組み込みシステムの会社を創業している。ただここは長続きしなかったようで、博士号取得後にはATM S.A.という会社に入社。こちらでさまざまなポジションを歴任しながら、最後には R&D部門のディレクターになっている。

Phoenix-RTOS-based frameworks

Phoenix-RTOS

Phoenix-DCU

Complete Phoenix-RTOS-based design framework including software and hardware modules (reference design, DCU application, PLC PRIME 1.3.6, 1.4, G3-PLC, IEEE 802.15.4 communication stacks) enabling Smart Grid DCU development.

Phoenix-SEM

Complete Phoenix-RTOS-based design framework including software and hardware modules (reference design, meter application with DLMS/COSEM, PLC PRIME 1.3.6, 1.4, G3-PLC, IEEE 802.15.4, W-Mbus communication stacks) enabling Edge-IoT smart meter development.

Phoenix-PILOT

Triplicated autopilot based on Phoenix-RTOS including software and hardware modules (reference design, pilot application, connectivity, optional DO-178C package) enabling certified UAV development (under development)

Phoenix-RTOS implementations (Smart Grid)

Software defined smart gas meter (battery device)

Belgium – 1M Fluvius
Poland – 20K PSG

384 KB

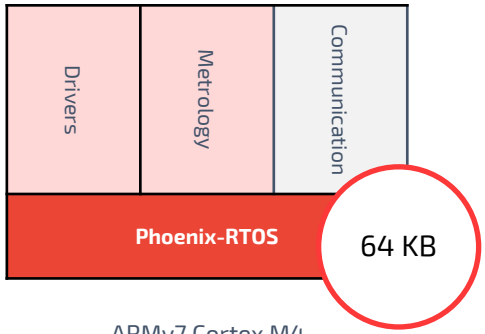
Software defined smart energy meter

1 MB

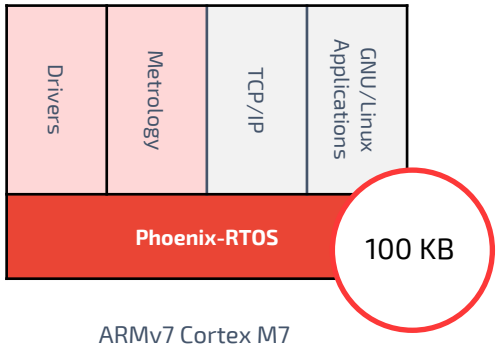
Software defined data concentrator

Poland – 37K Energa

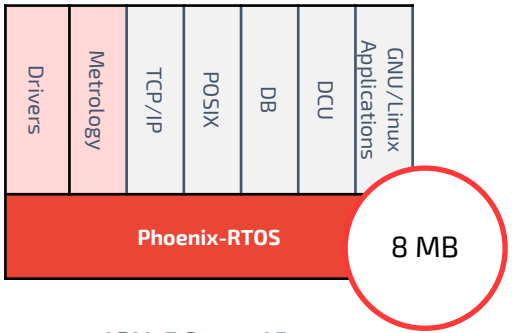
1 MB



ARMv7 Cortex M4



ARMv7 Cortex M7



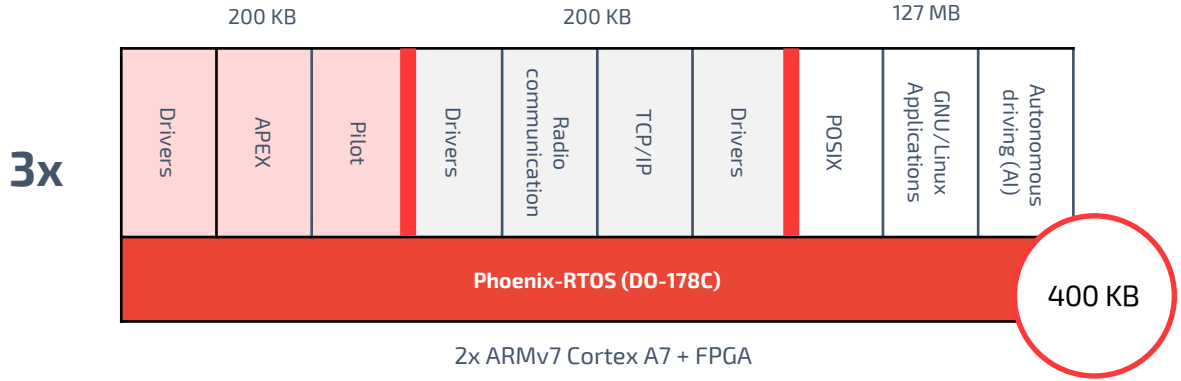
ARMv7 Cortex A5

Critical applications

Regular applications

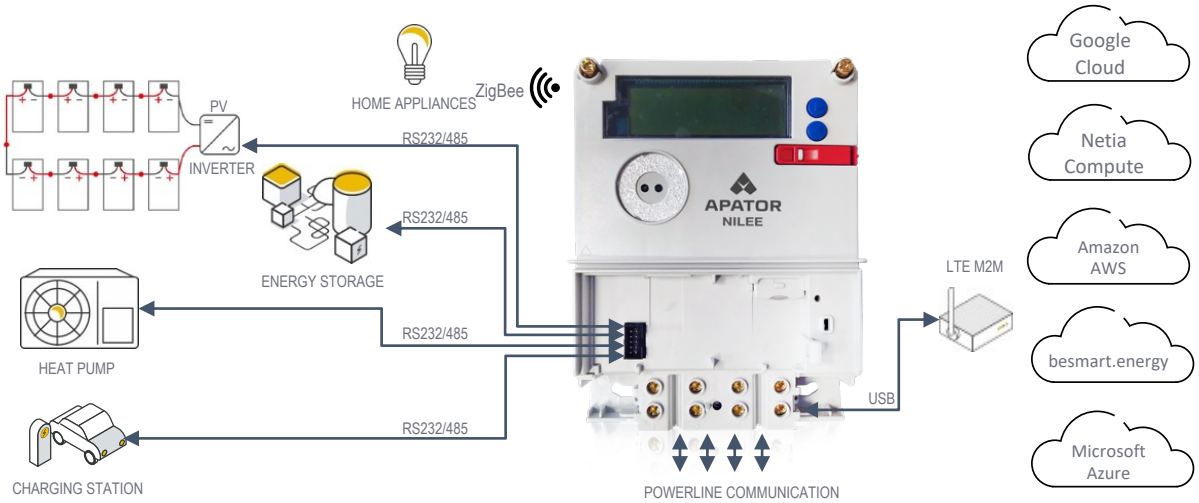
Phoenix-RTOS implementations (Aerospace, DO-178C)

Software defined, scalable autopilot for certified UAVs



Critical applications Regular applications Non-critical applications

Why Phoenix-RTOS is disruptive innovation?



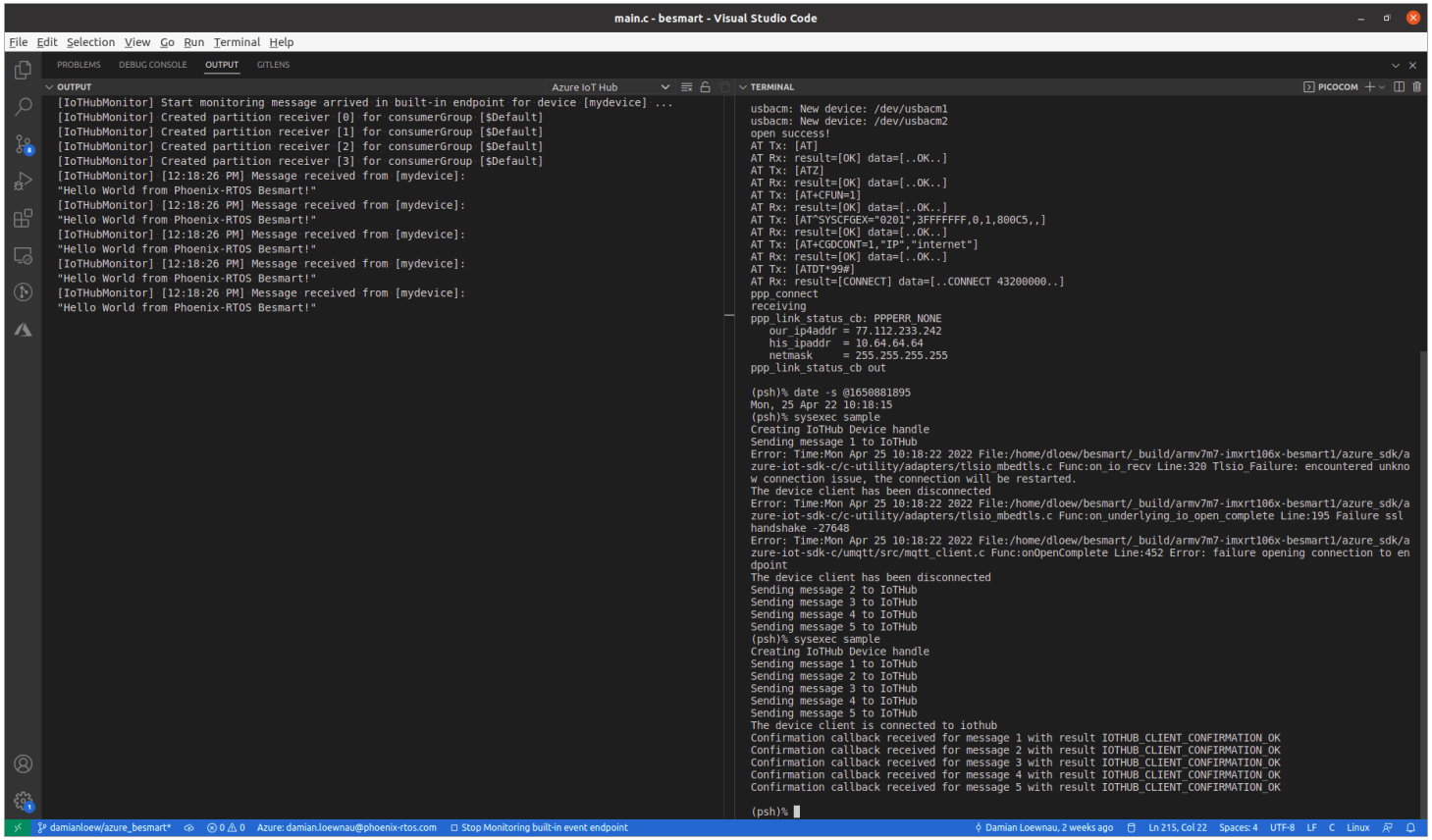

```
(psh)% ps
  PID  PPID PR STATE  %CPU  WAIT    TIME   VMEM THR CMD
    0     0  7 ready  58.8  88ms    0:44 231.5K   1 [idle]
    1     0  4 sleep   0.0   1ms    0:00      0   1 init
    2     1  4 sleep   0.0   1ms    0:00    18K   1 dummyfs
    3     1  2 ready  31.2   1ms    0:23  15.5K   7 imxrt-multi
    4     1  4 sleep   0.0   0us    0:00    18K   5 imxrt-flash
    5     1  4 sleep   1.2   1ms    0:00    21K   1 ad7779
    6     1  4 sleep   3.2   1ms    0:02    10K   1 oled-1280064B0
    7     1  1 sleep   5.0  79ms    0:03  99.5K   5 metersrv -u
    8     1  4 ready   0.0   1ms    0:00  28.5K   1 pshlogin
    9     1  2 sleep   0.2   1ms    0:00  28.5K   4 usb
   10     1  4 sleep   0.0   1ms    0:00    15K   3 usbacm
   11     1  3 sleep   0.0   1ms    0:00  76.5K   5 lwip pppos:/dev/usbacm0:up
```

- Phoenix-RTOS transforms smart meters into Edge-IoT devices that communicate with the cloud
- Users are able to create applications that allow to manage power generators, energy storage or household appliances
- This is a very important aspect from the point of view of the transformation of the energy sector and the implementation of the Green Deal assumptions

besmart.energy – Edge-IoT meter prototype

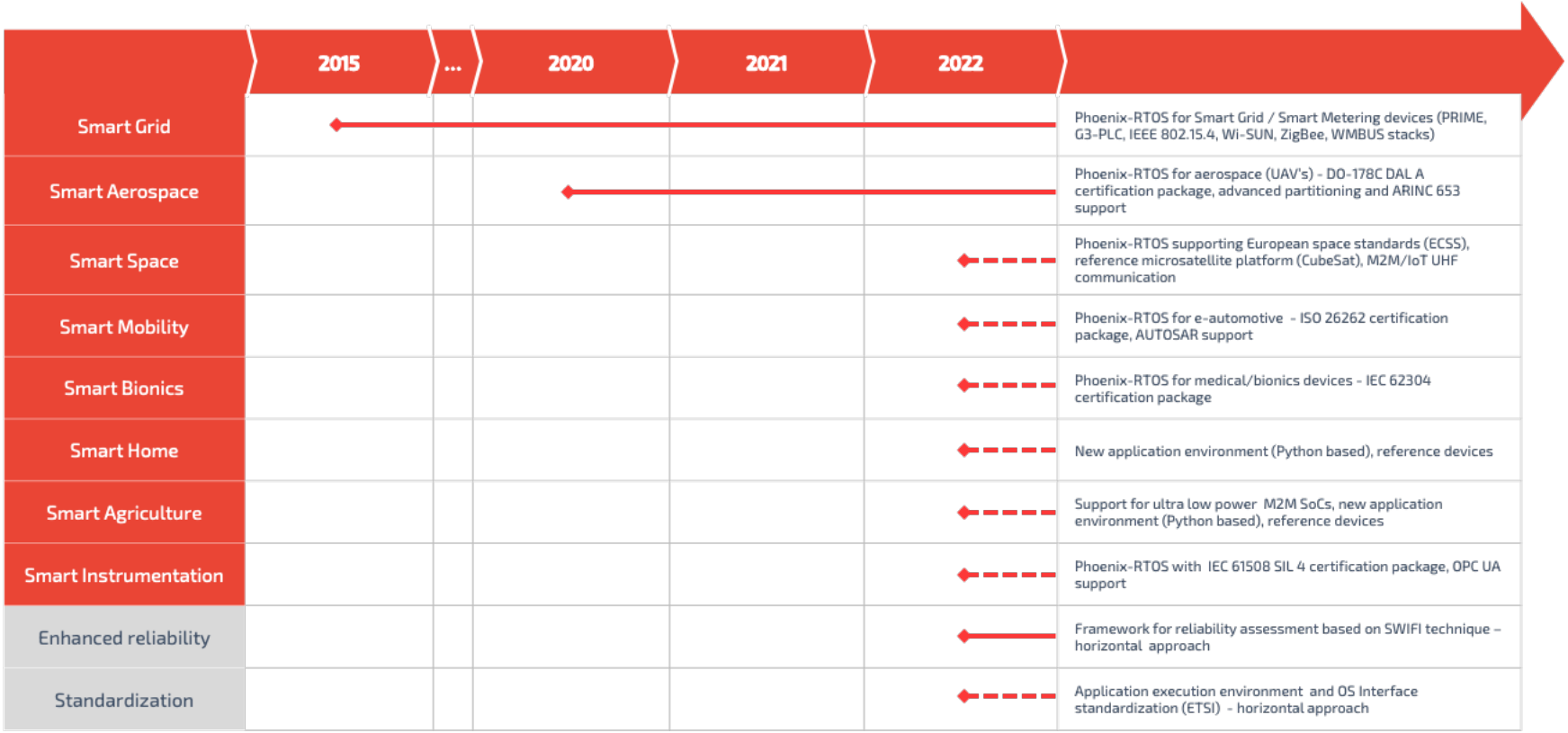

```
(psh)% ps
  PID   PPID PR STATE   %CPU   WAIT     TIME    VMEM THR CMD
    0      0  7 ready   61.3 356ms 11026:55    243K   1 [idle]
    1      0  4 sleep    0.0    1ms     0:00       0   1 init
    2      1  4 sleep    0.0    1ms     0:00   18.5K   1 dummyfs
    3      1  2 sleep   32.0   15ms  5780:51   18.5K   8 imxrt-multi
    4      1  4 sleep    0.0    2ms     1:21     18K   5 imxrt-flash
    5      1  4 ready    1.6   15ms   291:08   20.5K   1 ad7779
    6      1  4 sleep    4.2    3ms   767:49    9.5K   1 oled-1280064B0
    7      1  1 sleep    0.1 355ms    46:59    100K   5 metersrv -u
    8      1  4 sleep    0.0    0us     0:00    9.5K   1 hm hm@pshlogin
    9      1  2 sleep    0.0    3ms     2:08   25.5K   4 usb
   10      1  4 sleep    0.0    3ms     0:36     13K   4 usbacm
   11      1  3 sleep    0.0    8ms     1:49   65.5K   5 lwip pppos:/dev/usbacm0:up
   12      1  4 sleep    0.3    2ms    63:54     43K   2 gateway
   13      8  4 ready    0.0    1ms     0:00   33.5K   1 pshlogin
(psh)%
```

besmart.energy – Azure IoT Hub integration



IPCEI-CIS Project Work Packages

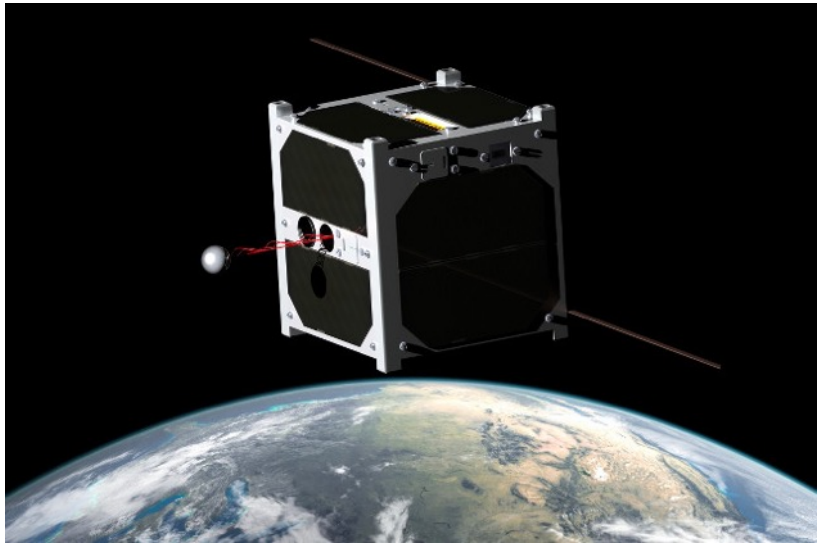
Phoenix-RTOS development roadmap



Phoenix - WP1 Smart Aerospace

- Commercialization phase 2028-2032
- Works – Phoenix-RTOS based software-defined autopilot and communication for certified unmanned aerial vehicles (UAVs)
- Output – EASA certification

Phoenix - WP2 Smart Space



- Commercialization phase 2028-2032
- Works – Development of reference 1U microsatellite platform based on Phoenix-RTOS to be placed in orbit in cooperation with ESA
- Output – ECSS certification package

Phoenix - WP3 Smart Mobility

- Commercialization phase 2028-2032
- Works – Development of the autopilot (software and hardware) with the resource triplication dedicated to control vehicle elements (autonomous driving integration)
- Output – ISO 26262 certification
- **Collaboration: Polonez concept EV car made by FSO Syrena in Kutno**

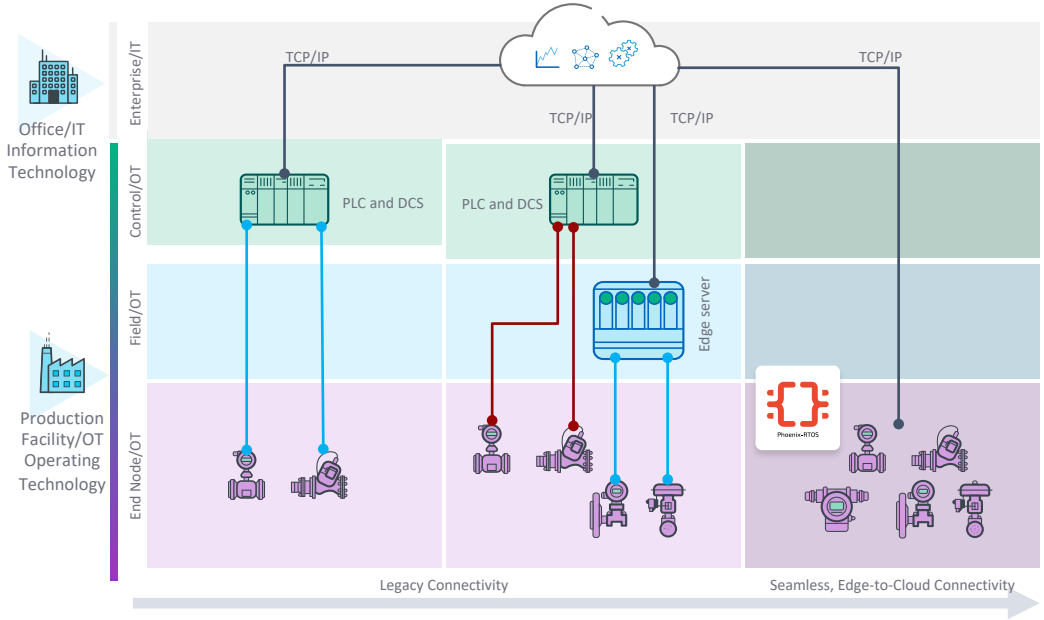
Phoenix - WP4 Smart Bionics

- Commercialization phase 2028-2032
- Works – Prototype of the smart limb bionic prothesis (software and hardware)
- Output – Compliance with the requirements of the MDD directive (IEC 60601 standard)

Phoenix - WP6 Smart Agriculture

- Commercialization phase 2026-2032
- Works – Phoenix-RTOS adaptation to ultra low-power M2M SOC devices with integrated LTE Cat-M1/NB-IoT and IEEE 802.15.4 communication
- Output – Prototype of the Agro Edge-IoT low-power Phoenix- RTOS based computer to control animal /plant production with IEEE 802.15.4, LTE M2M and satellite M2M connectivity
- **Collaboration: Phoenix-RTOS based sensors development and implementation with Andra**

Phoenix - WP7 Smart Instrumentation



- Commercialization phase 2028-2032
- Works – Development and implementation of a control and measurement device supporting OPC UA with industrial partners
- Output – Sensor Box (Phoenix-RTOS based)

Phoenix - WP8 Phoenix-RTOS core

Phoenix-RTOS

- Commercialization phase 2026-2032
- Works – Development works resulting in open-source release of Phoenix-RTOS including partitioning mechanisms, build environment, applications for orchestration and Edge-IoT devices management
- Output – Standardized foundation API and cross-domain API extensions for multiple industrial platforms

Edge-IoT Alliance and it's connection to Gaia-X

Edge-IoT Alliance and it's connection to Gaia-X

Edge-IoT Alliance in Brussels will be established to define and promote common standards for Edge-IoT operating system

https://edge-iot-alliance.org/

gaia-x

Edge-IoT
ALLIANCE