Real-Time at the Charger: Zephyr RTOS in EVSE Applications

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- Saravanan Sekar, Linumiz GmbH
  - Embedded Linux and Zephyr RTOS development, consulting, training
  - Embedded Linux development: BSP, u-boot, Linux Kernel, Yocto Project, Buildroot
  - Zephyr: SoC, Board support, drivers
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Linumiz and its offering

Linumiz is a domain-agnostic embedded software engineering and consulting company specializing in Linux and Zephyr RTOS. Our expertise spans board bring-up, Board Support Package (BSP) development, device driver implementation, and over-the-air (OTA) software updates, primarily for ARM-based systems but not limited to them. We empower businesses with tailored embedded solutions, ensuring reliability, scalability, and seamless hardware-software integration.

Embedded Linux

- Board support package
- Driver Development
- Board Bring up
- Custom Linux build
- Application Development

Zephyr RTOS

- Board porting
- Firmware Development
- Driver development
- Update management
- Upstream activities

Consulting

- HW recommendation
- Architecture design
- System development
- Support for specific issues
- Support Services

Device security

- Static analysis
- Dynamic analysis
- Device hardening
- Root of Trust (RoT)
- Security recommendations

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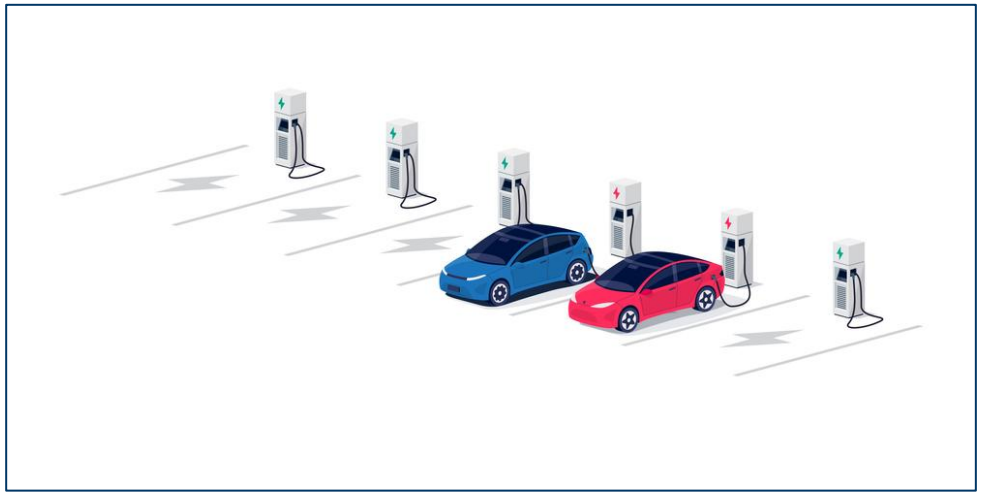
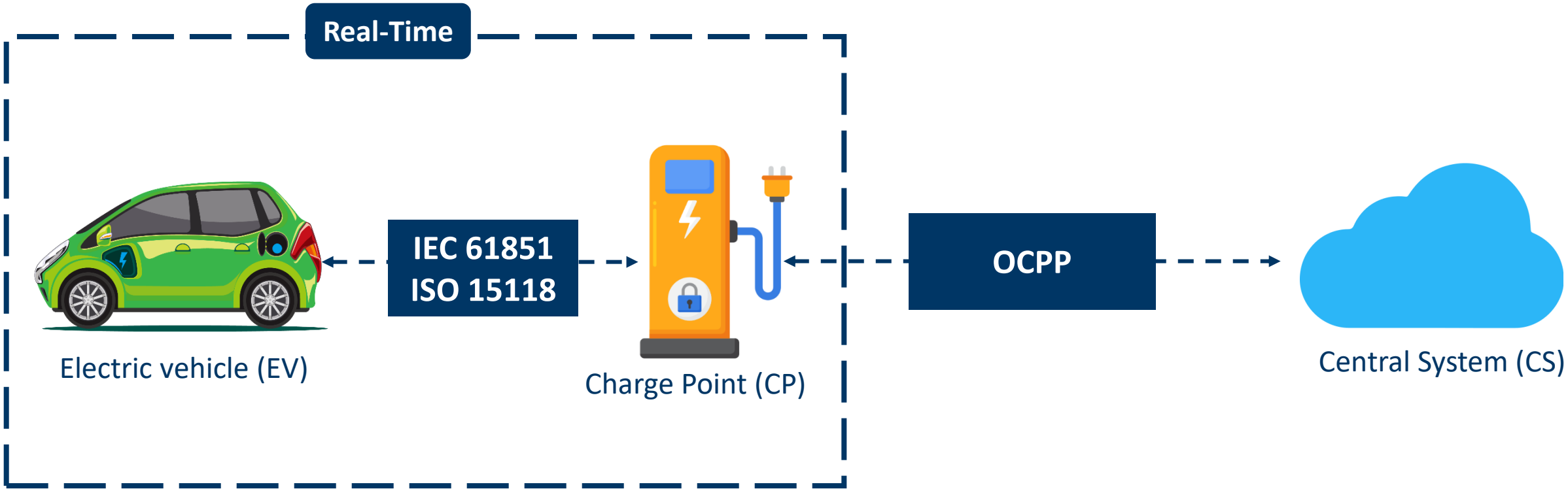
Electric Vehicle (EV) and charging infrastructure



- Electric vehicle supply equipment (EVSE) supplies electricity to an electric vehicle (EV), commonly called charging stations or charging docks
- Lack of charging infrastructure
- EV charging duration is high and occupies a huge parking space
- EVSE is portable and easy to install in most parking space
- More distributed lightweight charging station is needed

EVSE Overview and need for Real-Time

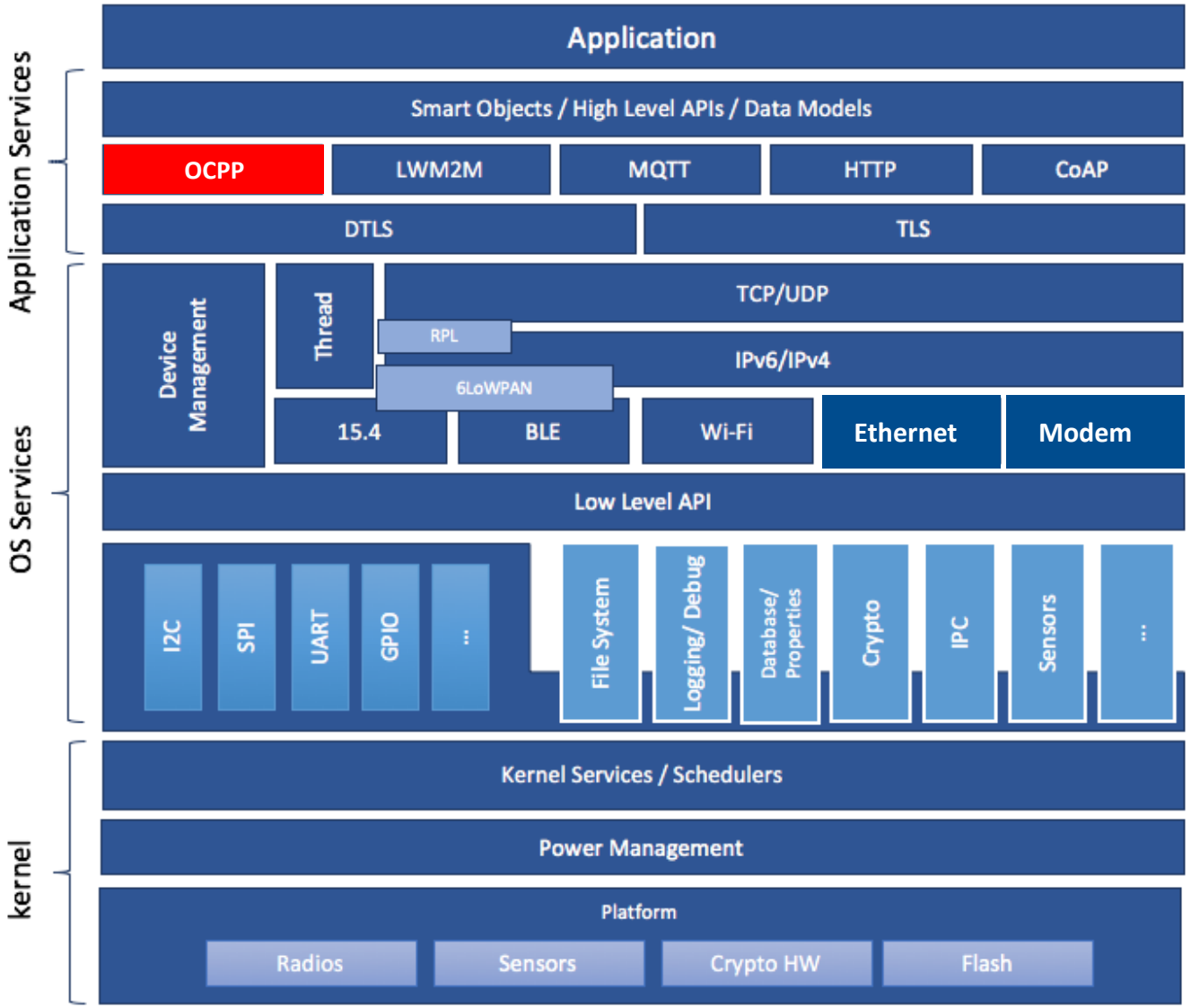


- The evolution of Electric Vehicle Supply Equipment (EVSE) demands real-time control

Zephyr RTOS, a lightweight, modular, and real-time capable operating system, enables deterministic control over critical EVSE functionalities such as power management, overcurrent/fault protection, load balancing etc., aligns with modern EV charging standards

Modular EVSE with Zephyr on Microcontroller

- Standalone complete solution using Zephyr RTOS
- Low to medium capacity
- OCPP application protocol stack
- Transport layer for OCPP ethernet, modem, or Wi-Fi
- Energy Meter & Peripherals communication protocol like CAN, Modbus, SMbus, PWM
- Security features (TLS, secure boot, OTA updates)



Ref: https://docs.zephyrproject.org/latest/_images/security-zephyr-system-architecture.png

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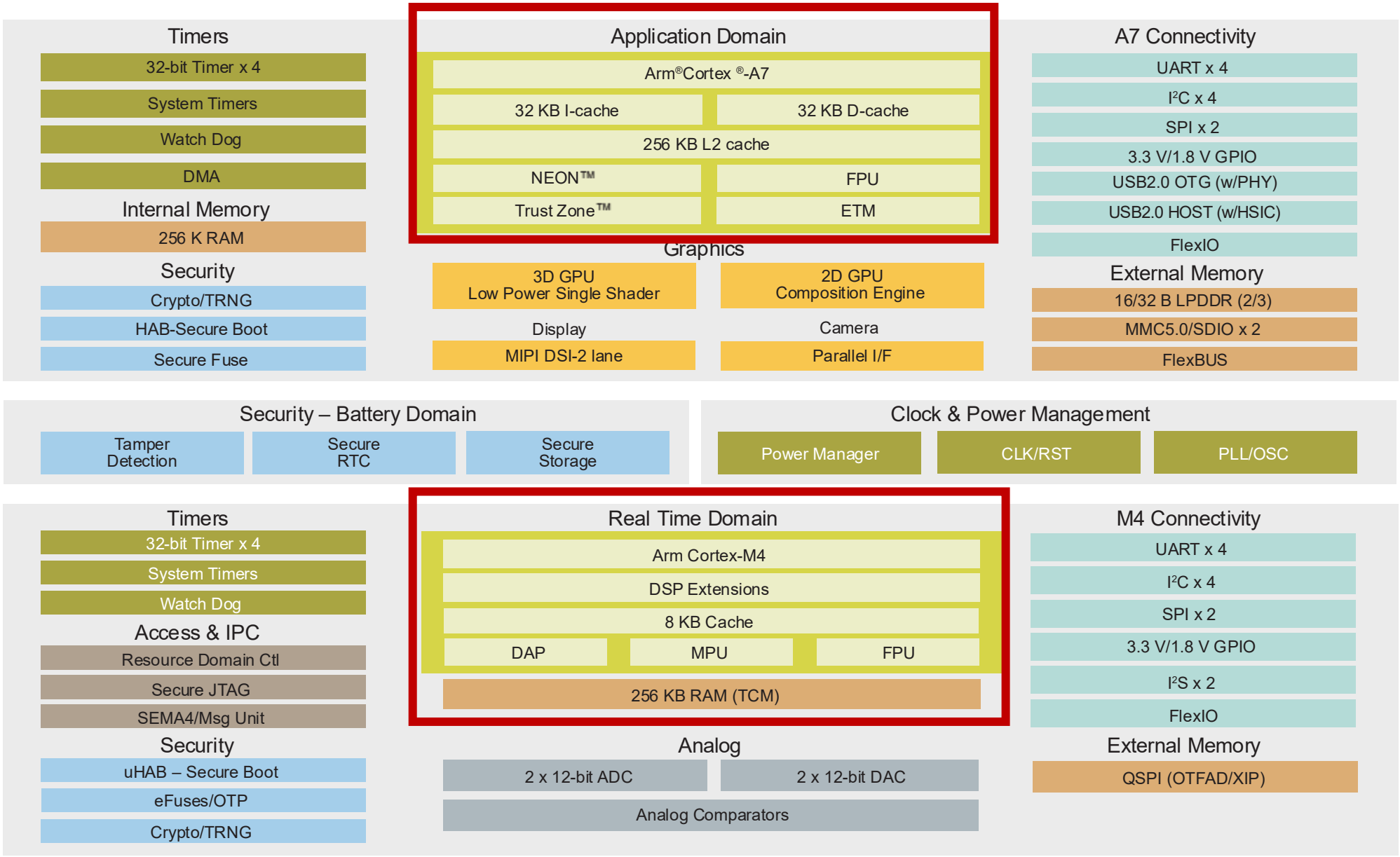
High Performance EVSE with Linux and Zephyr RTOS



Ref: https://www.nxp.com/products/i.MX7ULP

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High Performance EVSE with Linux and Zephyr RTOS

- A heterogeneous SMP platform offers multi-cores with distinct capabilities
- Enables parallel execution of time-sensitive operations alongside high-level processing tasks.
- Linux used for HMI, networking, OCPP, etc.,
- Zephyr used for real time controls, charging state machine
- inter-processor communication (IPC) using RPMsg Protoctol and OpenAMP.

Thank You

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