



Time-critical Edge Compute blueprint

<https://wiki.akraino.org/display/AK/Time-Critical+Edge+Compute>

What are the drivers for “Time-Critical” edge compute BP?

- Industry 4.0 driving transformation at the Industrial Edge
 - Traditional ISA 95 levels “collapsing”
 - Fixed function device to software defined workload
 - IT to OT transition
 - OPAF -> new standard for Process Manufacturing
- Industrial edge is heterogenous
 - Mixed architectures
 - Mixed networking
 - Mixed criticality functions, including functional safety
- Latency and deadline sensitive
 - Determinism
- Time-sensitive networking
 - East/West and North/South
 - Ethernet TSN and TSN over 5G



THINGS

EDGE COMPUTE

ENTERPRISE

CLOUD

IOT Endpoints
(Control, PLCs)

Private Cloud Servers
(Advanced Control, Insights)

Networked Appliances
(Gateways, Firewalls)

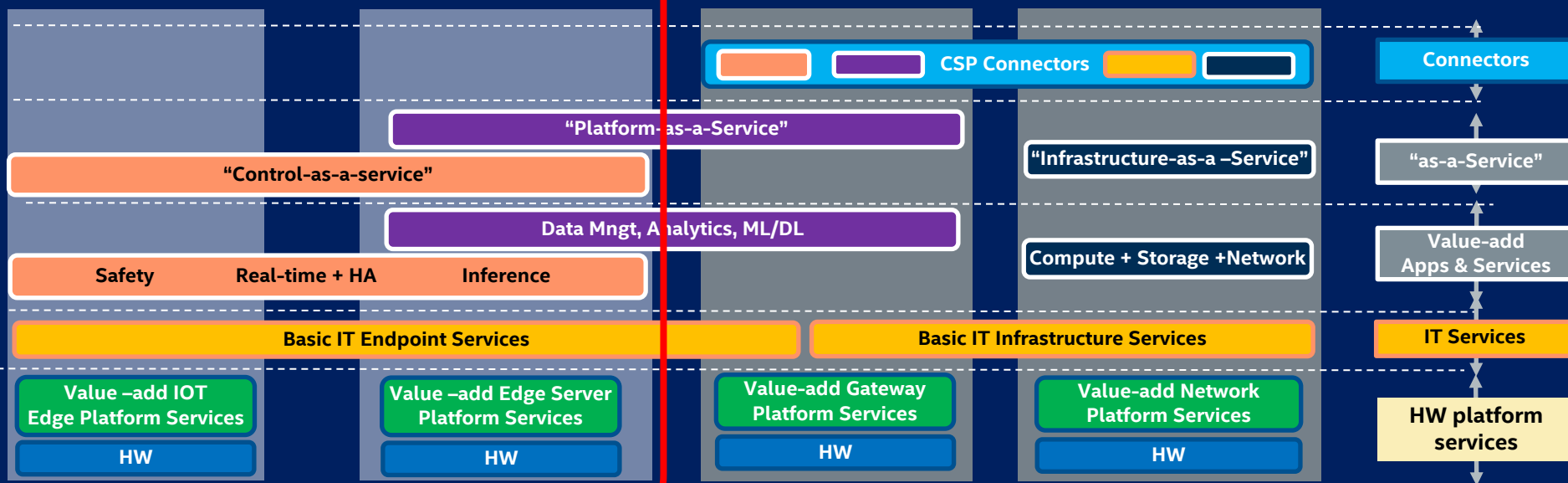
Infrastructure
(Servers, LAN, WAN, VNF's)

ISA95 – L1/2
<10ms

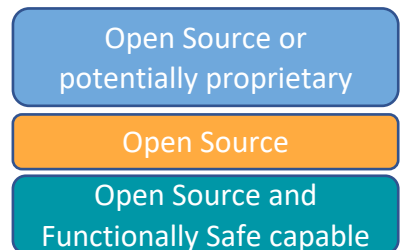
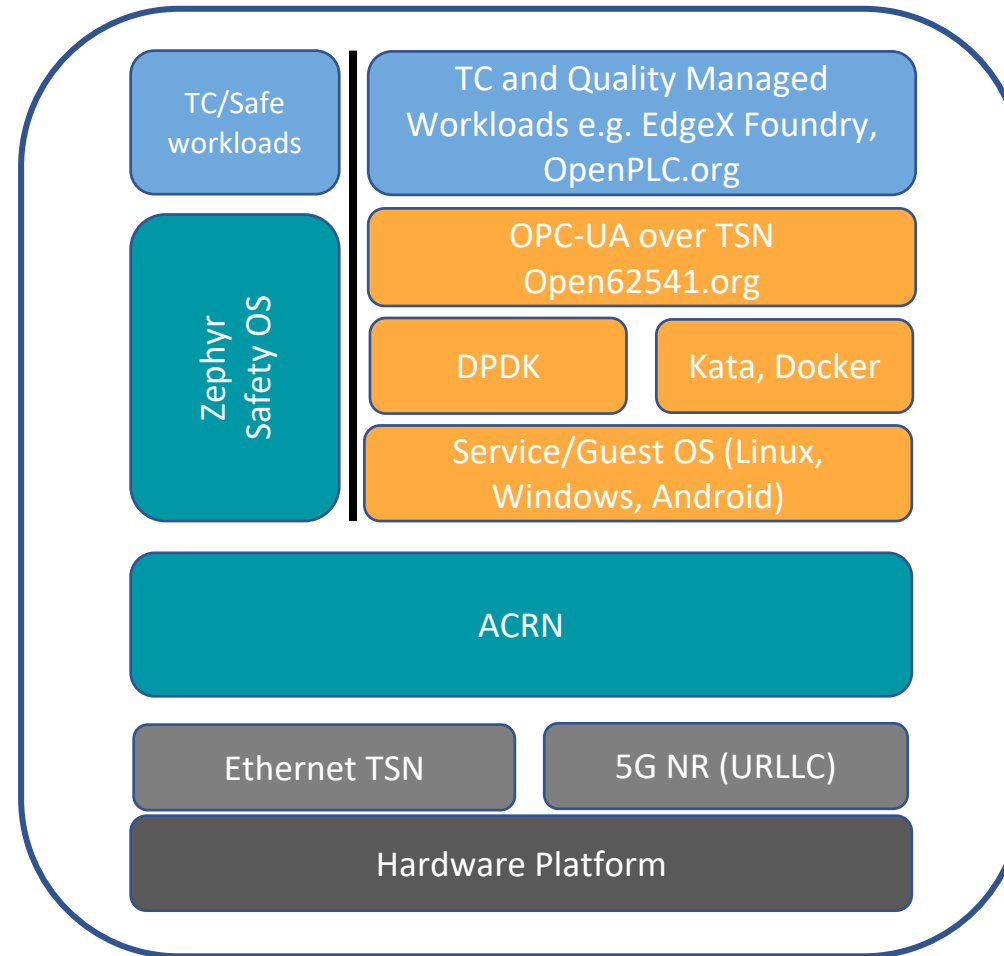
ISA95 – L2/3
<100ms

ISA95 – L3/4
<500ms

ISA95 – L4
>500ms



Time-critical Edge Compute BP: Reference Architecture



*Other names and brands may be claimed as the property of others

Time-critical Edge BP – Sample Use Cases

- Use cases in Manufacturing, Smart Buildings, general IIOT
 - Workload consolidation
 - Virtualized PLC
 - Computer vision inference
 - Machine, sensor data inference
 - Process or discrete manufacturing closed loop control
- Functional Safety capable use cases
 - Discrete manufacturing soft PLC
- Onramp for 5G-URLLC UE use cases

Time-critical Edge BP – Sample Workloads

- Containerized (Docker or Kata) workloads orchestrated via Kubernetes (or equivalent) tuned for embedded, time-critical deployments
- Sample workloads include:-
 - Tensorflow via Kubeflow
 - OpenVINO for Machine Vision Inference
 - Closed loop control (e.g. IEC 61131-3)
 - Human Machine Interface (HMI)
 - EdgeX Foundry
 - Building automation controller

Time-critical Edge Compute Blueprint

- SW Contributors
 - Intel
 - IOTech Systems
 - *Huawei*
 - *WiPro*
- Commercial Hardware Vendors
 - *Dell (x86), HPE (x86), Huawei (ARM)*

Time-critical BP – Validation Lab (UNH)

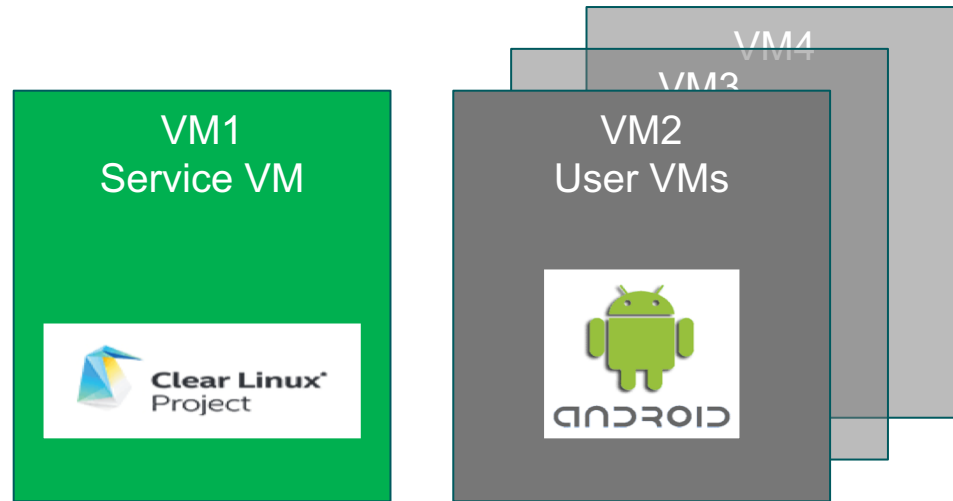
- 3 x Intel Atom-based NUC's
- NOTE: Akraino CI not yet enabled

Time-critical BP – R2 Plans

ACRN 1.0



Usage: Sharing Mode



Key Features

- **Safety and Security Isolation (Cluster + IVI)**
- **Extensive I/O Sharing Capabilities**
 - Graphics, media, USB, audio, camera etc.
 - Advanced DMA/graphics buffer sharing
- **Multiple OS Support**
 - Clear Linux, Yocto, Ubuntu
 - Android, AliOS
- **MISRA-C Compliance**

Ready for Production

- **100% Feature Test Coverage**
- **High Stability**
- **Fast Boot and Performance KPI**
- **100% CTS Pass for Android Guest**

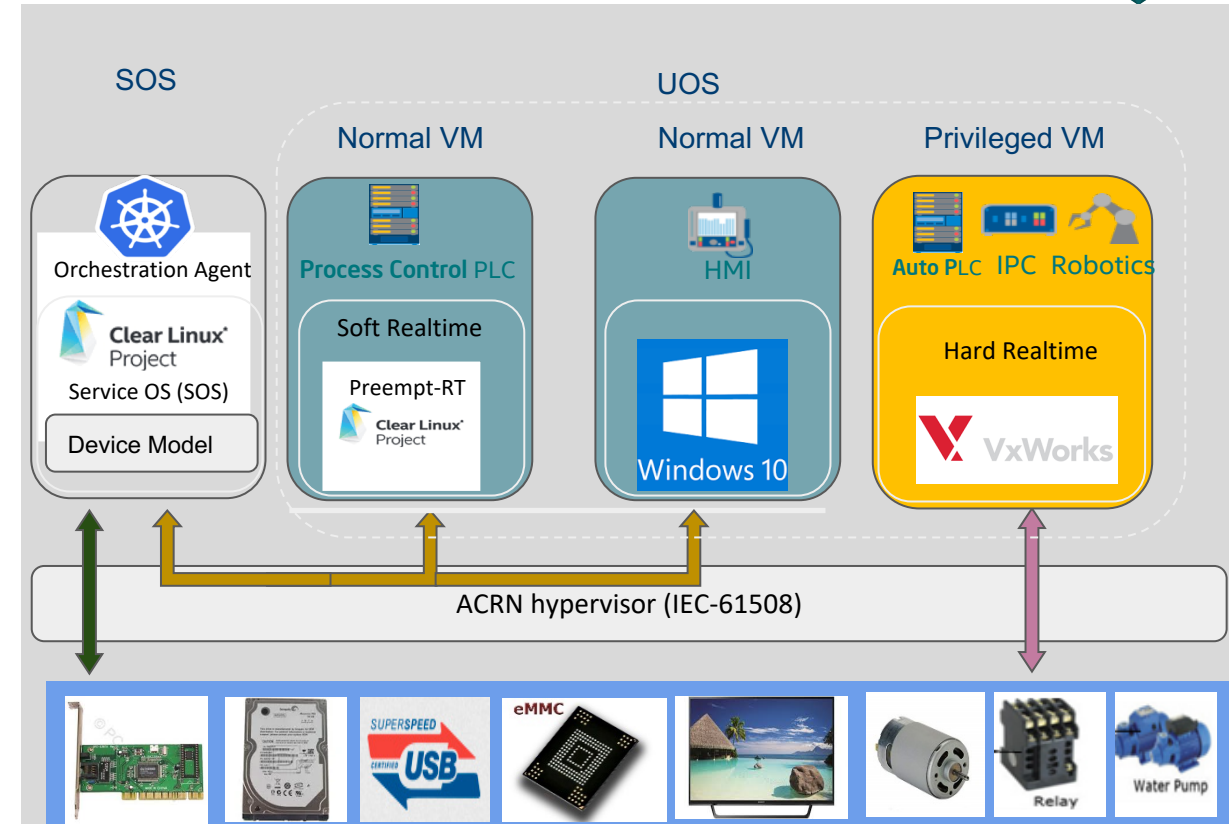
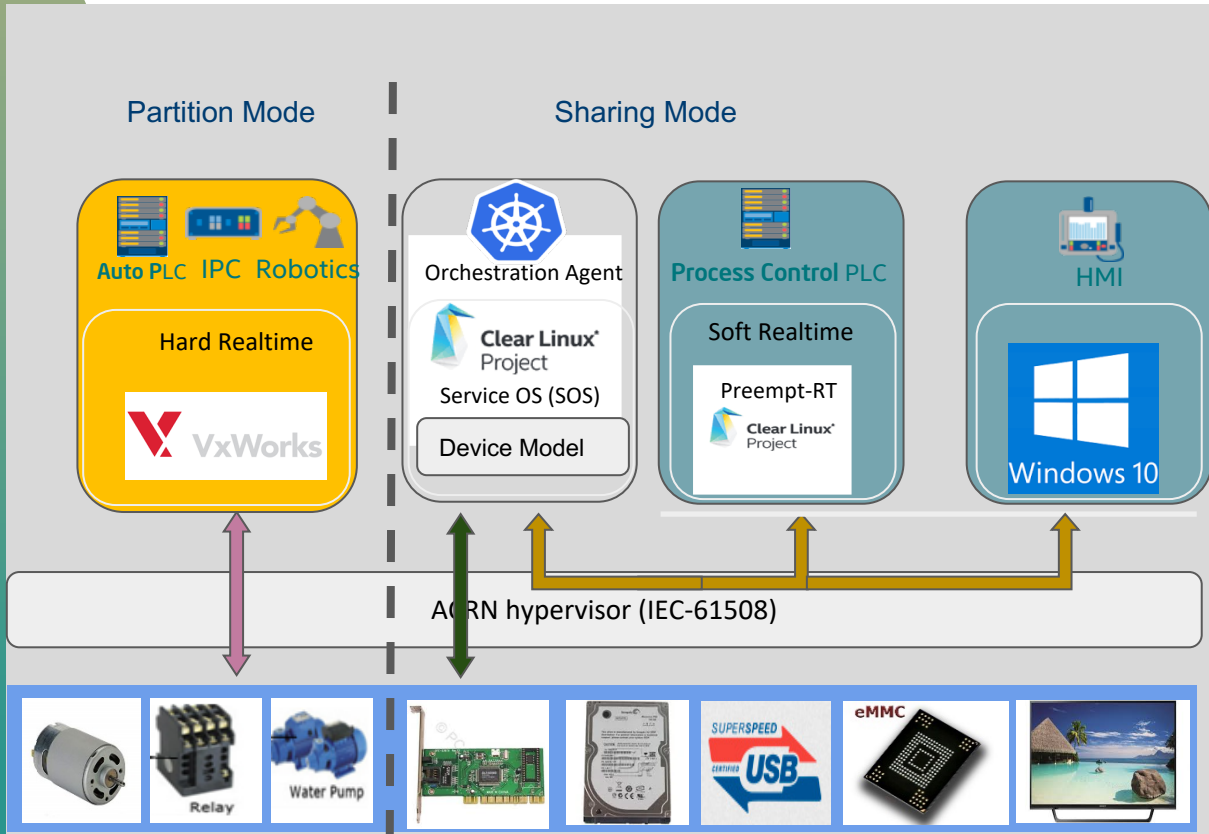
Released in May 2019 @github.com/projectacrn/



Looking Forward – ACRN 2.0 (Q4'19)

- Flexible architecture to support diverse IoT usages
 - Partitioning Mode and Hybrid Mode
- Hard Real Time: VM Exit Less; minimize impact of “noisy neighbor”
- More guests OS support
 - Windows, VxWorks, Zephyr, RT-Linux
- Production-ready reference solution for Industrial Usage
- FUSA certification

Industrial Usage: Hybrid Mode

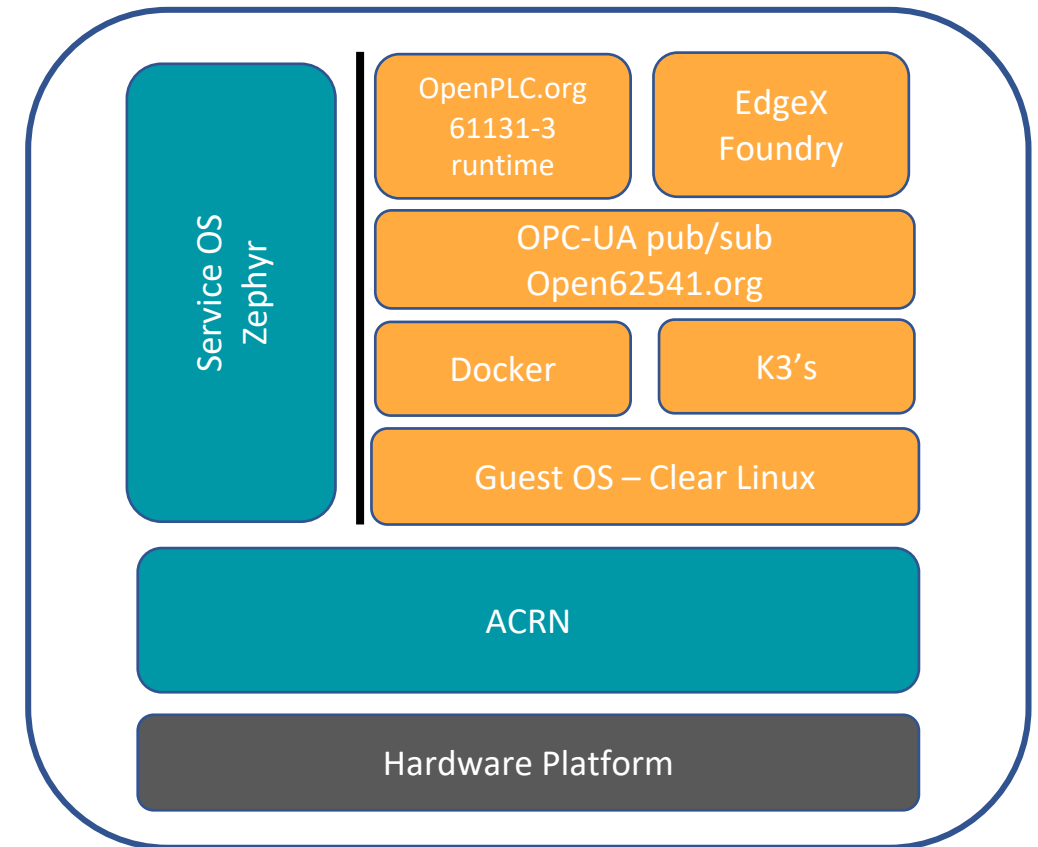


- Hybrid Flavor 1: Privileged VM loaded by hypervisor, totally independent from SOS
- Hybrid Flavor 2: Privileged VM loaded and controlled by SOS but access IO directly
- Typical Usage in industry: HMI + Soft RT OS + Hard RT OS

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Time-critical BP – R2 plans (proposal)

- Simple config of upstreams:-
 - ACRN hybrid mode
 - No RT-OS / workloads
- CI setup
- Test/validation scripts created
- Use case:-
 - SoftPLC with relaxed KPI's
 - Dummy machine data for I/O
 - Data management/visualization via EdgeX
- Proof points:-
 - Validate config
 - Ecosystem engagement



Call To Action for Akraino Community

- Bring your time-critical use cases and come join us!
- Deterministic manageability infra (container, VM, SW etc.) is a gap
- Bi-weekly calls (every 2 weeks)
 - Monday @ 9am pacific