Time-critical Edge Compute blueprint

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

PTL - Shane Dewing (@Shane Dewing) (Intel Corp.)
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

IOT Endpoints (Control, PLCs)

Private Cloud Servers (Advanced Control, Insights)

Networked Appliances (Gateways, Firewalls)

Enterprise

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

"Infrastructure as a Service"

Value-add IOT Edge Platform Services

Value-add Edge Server Platform Services

Value-add Gateway Platform Services

Value-add Network Platform Services

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"Control-as-a-service"

Data Mgmt, Analytics, ML/DL

"Platform-as-a-Service"

Connectors

"as-a-Service"

Value-add Apps & Services

IT Services

HW platform services
Time-critical Edge Compute BP: Reference Architecture

- Open Source and Functionally Safe capable
- 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)

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

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

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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