Zephyr™ Project
Developer Summit
June 8-10, 2021 ▪ @ZephyrIoT

ACRN Hypervisor and Zephyr RTOS for Industrial IoT Applications

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Introduction

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- Who am I?

  Engineer in sensor systems, 10+ years
  - Zephyr Project developer, ~2 years
  - X86 Platform Enabling and Arch
  - Usability, Sensing, +Disruptive tech

- What are we talking about today?

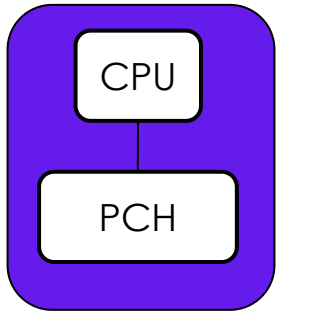
  Open-source ACRN hypervisor and Zephyr RTOS can be used together on x86-based platforms

- Why?
  - Growth of open-source ecosystem to meet real-time requirements for embedded and virtualized systems
  - Flexibility with scalability - hypervisor support extending beyond one platform or use-case
  - Permissive Apache 2.0 licensed reference source code, device drivers to enable entire ecosystem

Sources (left, clockwise): ntxe-news.com; photo by Gary Payne, northtexan.unt.edu; self; radiowirelessweek.org

Concept Overview – HW and Deployments

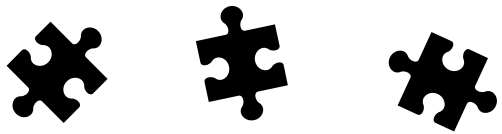
- Requires SoC and Board definition for PC-like boards in the RTOS that are easily adaptable and upstreamed
- Enable diverse platform implementations and applications

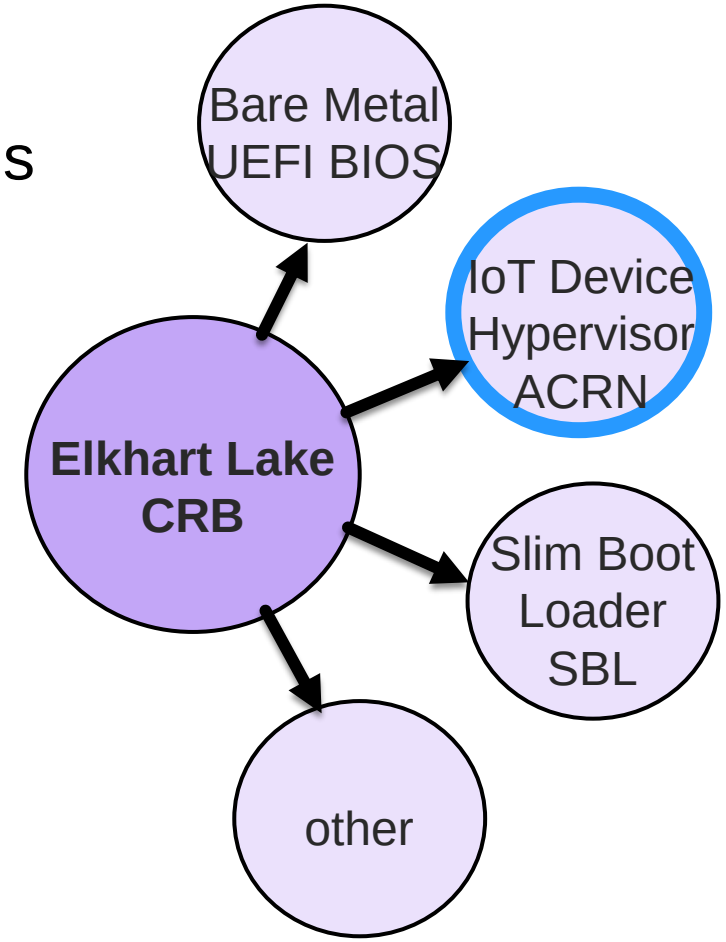


Multi-chip Package (MCP)

Example

Intel Atom® Series x86
Elkhart Lake (EHL)
using Zephyr on top of ACRN
Device Hypervisor
for Industrial IoT



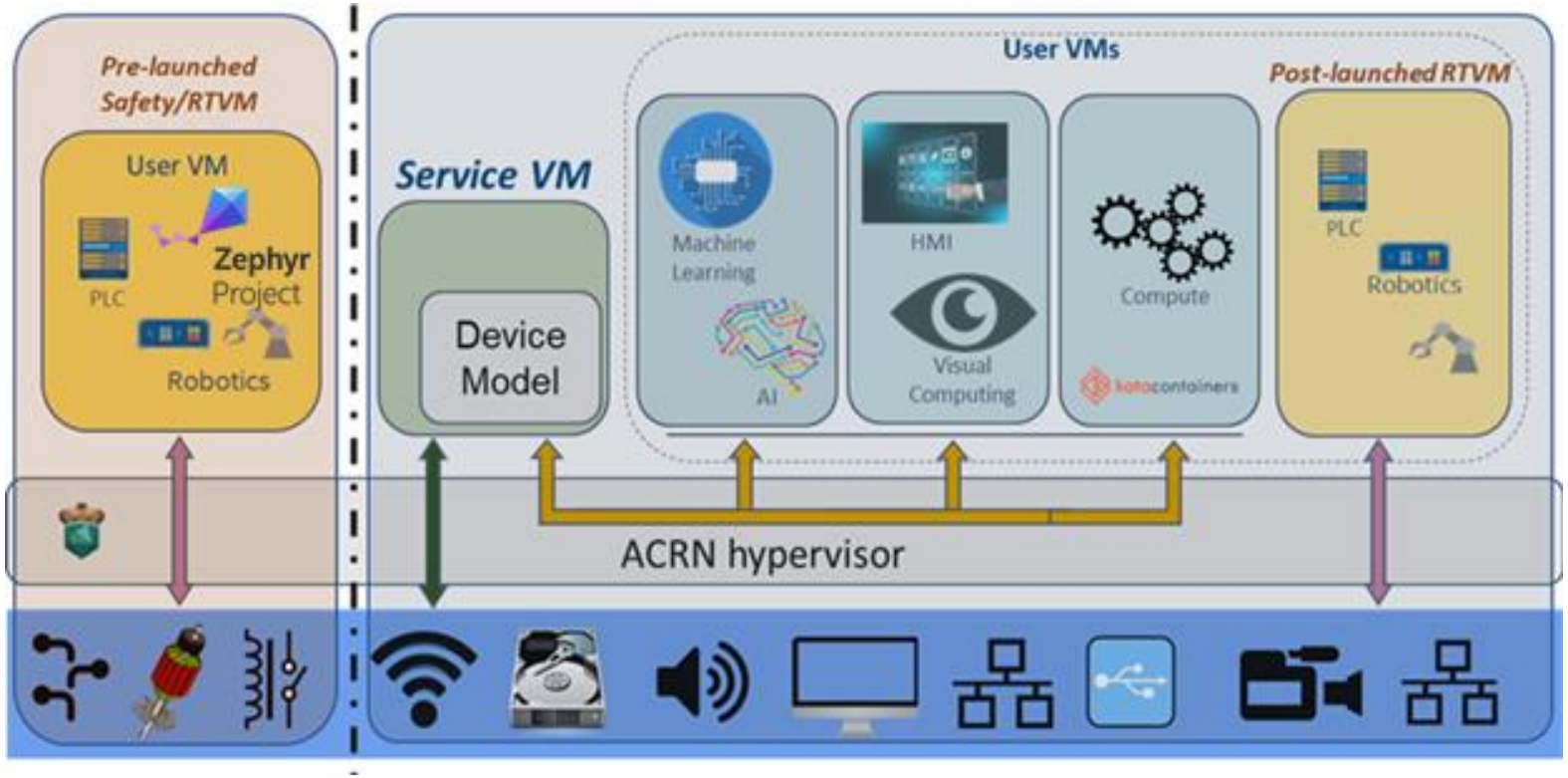


Reference: intel.com/content/www/us/en/products/platforms/details/elkhart-lake.html

Concept Overview - Virtualization

- Combine to leverage
  - isolated virtual machine (VM) environment of the hypervisor
  - real-time capabilities of the operating system
- Reliability & Customizable
  - Idea is one OS can crash while the others are unaffected
  - VMs with a different OS can launch at boot or later by main OS ('service' OS) or user
- Existing development for hypervisor and VM use-cases

Example
Hybrid Real-Time (RT) Scenario
with Zephyr RTOS as pre-launched real-time User VM



Source: projectacrn.github.io/latest/introduction/index.html#hybrid-real-time-rt-scenario

Demonstrated Use

- Build your Zephyr App

```
west build -b acrn_ehl_crb samples/hello_world
```

- Configure and build ACRN (see boards/x86/acrn)
- Assemble EFI Boot Media (on bootable USB device)
- Boot ACRN

```
ACRN:\>vm_console 0
----- Entering VM 0 Shell -----
*** Booting Zephyr OS build v2.6.0-rc1-324-g1a03783861ad  ***
Hello World! acrn
```

- Testing with twister using --west-flash

```
/zephyrproject/zephyr/scripts/twister -p acrn_ehl_crb --device-testing \
--device-serial-pty="/opt/testhw/acrn-test-pty.exp,ehlcrb"             \
--west-flash="/opt/testhw/testhw-x86-acrn.sh,ehlcrb" -vv -T            \
~/zephyrproject/zephyr/tests/kernel/common
```

Example – Canonical™ at Embedded World 2020 - Ubuntu® in parallel with Zephyr RTOS, ACRN

- On Intel NUC® reserved a core and a small amount of memory for Zephyr; rest of system resources for Ubuntu
- ACRN takes system control on boot, then starts Zephyr & Ubuntu
- Zephyr output on small display & Ubuntu on large display
- Zephyr unaffected by the additional Ubuntu payload

Source: zephyrproject.org/creating-real-time-ready-systems-with-acrn-and-ubuntu/

Demonstrated Use and Examples of Use-cases

- Example use-cases include industrial IoT applications

Manufacturing

Logistics

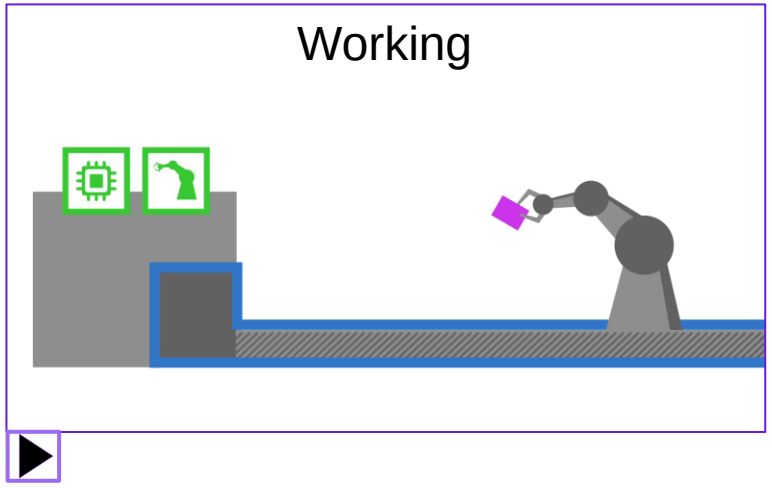
Utilities

Oil and Gas

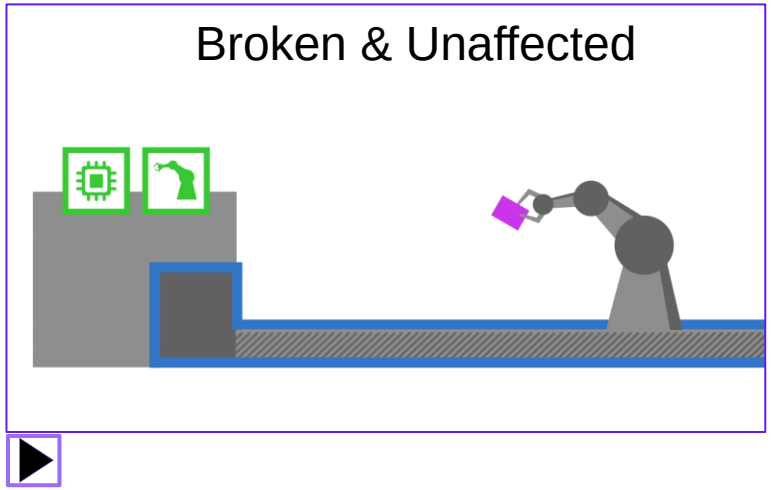
Smart Buildings

- Example of control/flows

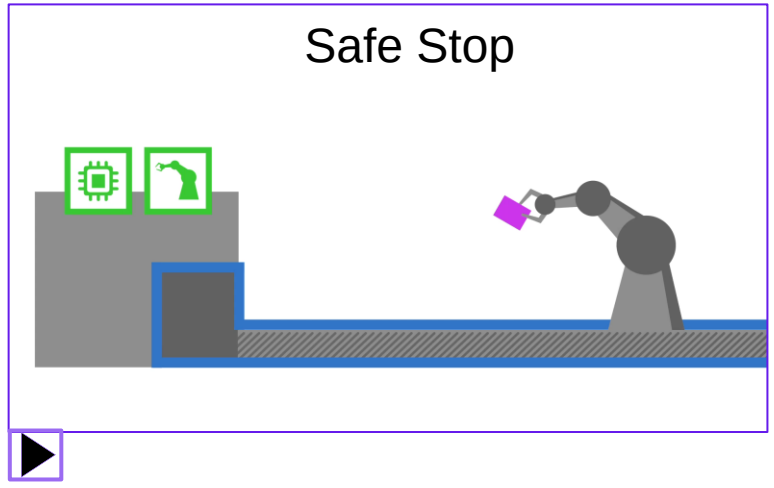
Working



Broken & Unaffected



Safe Stop



Animation Credit: Brandon Morgan, brandonmorgan.net

Wrap-up

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Today's Example:
Intel ® x86 Elkhart Lake (EHL) using Zephyr on top of ACRN Device Hypervisor for Industrial IoT

- Takeaways
  - Open-source ACRN IoT device hypervisor and Zephyr RTOS can be used together to leverage benefits of each
  - Built to be highly customizable and reliable
  - Used methodology that is replicable and scalable to grow with the ecosystem
  - Applies to real-time and safety-critical applications
- More information & resources
  - https://docs.zephyrproject.org/latest/boards/x86/acrn/doc/index.html
  - https://projectacrn.github.io/latest/getting-started/building-from-source.html
  - https://projectacrn.github.io/latest/tutorials/using_zephyr_as_uos.html
  - https://www.zephyrproject.org/creating-real-time-ready-systems-with-acrn-and-ubuntu/
  - https://www.zephyrproject.org/demo-of-workload-consolidation-on-edge-devices-with-project-acrn-zephyr-rtos-intel-and-docker/


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