China RISC-V Summit 2023

The ACRN/RISC-V project: embedded hypervisor design and status update

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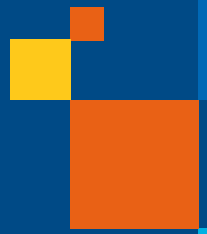

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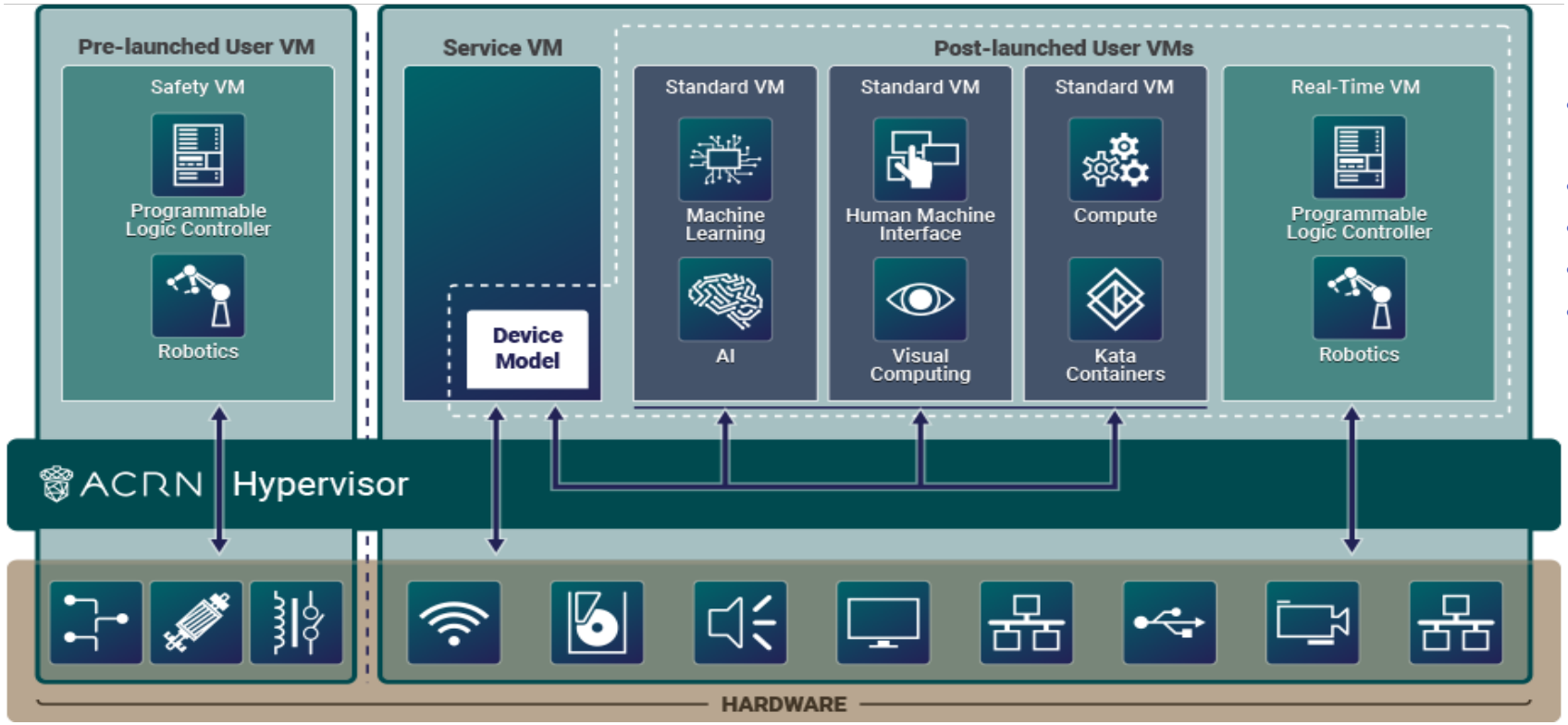
ACRN Introduction

ACRN™ is a flexible, lightweight reference hypervisor, built with real-time and safety-criticality in mind, optimized to streamline embedded development through an open source platform.



- A Linux Foundation Project launched in March 2018
- Version 1.0 released in May 2019
- Version 2.0 released in June 2020
- Version 3.0 released in June 2022
- Version 3.2 released in Aug 2023

ACRN Key Capabilities

Hard Real-time
Support hard or soft RT VM
Optimized for RT, e.g. no VMExit, cache isolation

Rich I/O Mediation
Graphics, Audio, USB...
Industry standard Virtio BE/FE drivers

Flexible Architecture for Diverse IoT Usage
Partition Mode, Shared mode
Hybrid (mix of partition & shared) mode

Various Guest OSes Support
Android, Linux, Zephyr, VxWorks, Windows...

Secure Container
KATA containers enables added security
Kubernetes support for KATA, enables ease of deployment & management

Security & Isolation
Full isolation for mixed criticality workloads
Hardware assisted isolation
Secure boot

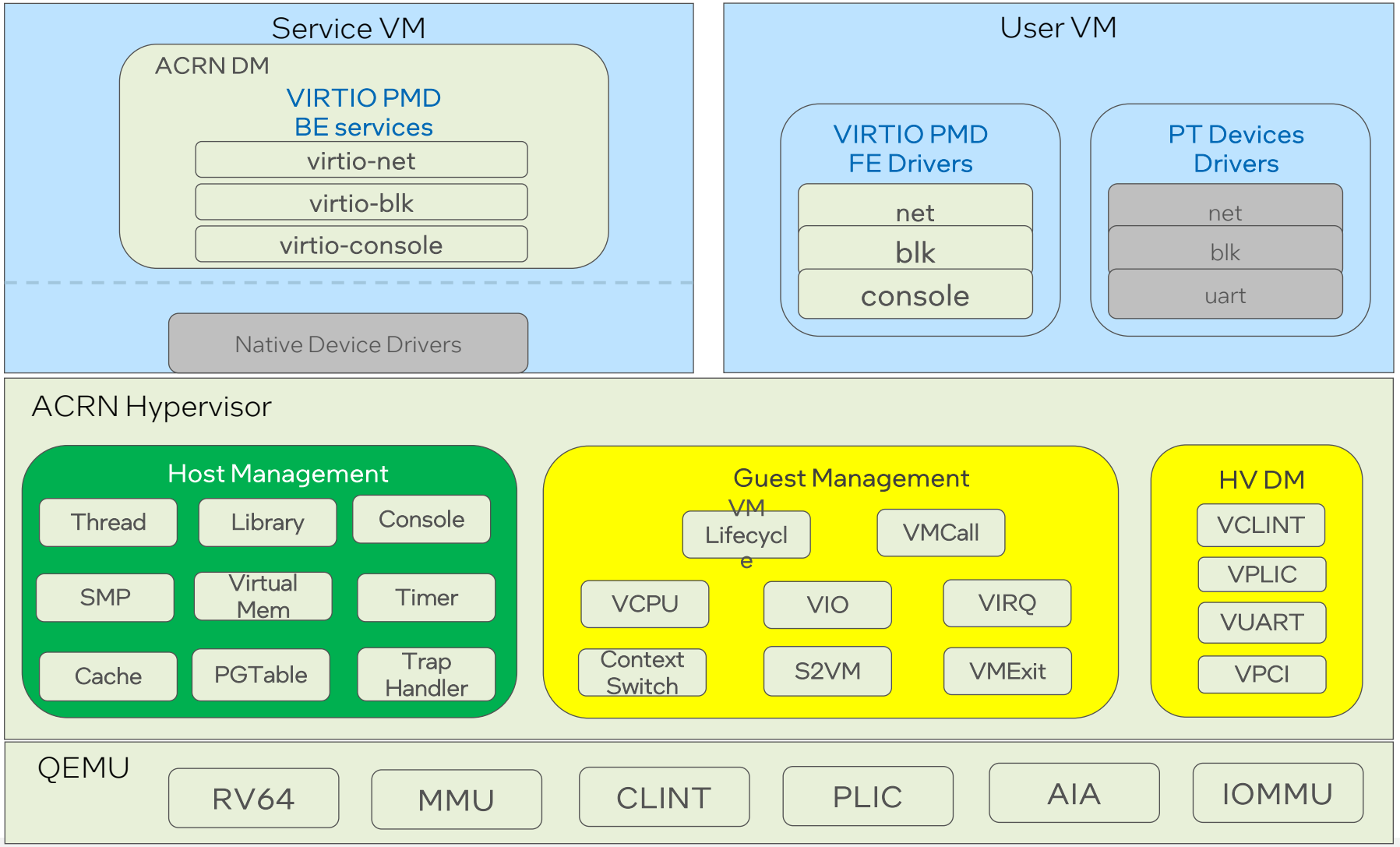
Permissive Open Source License
Permissive BSD-3-clause license
Linux Foundation Affiliation

System Manageability
Flexible VM lifecycle Management

Safety in Mind
Small footprint
Coding guideline

Ease of use
ACRN configuration tool
Rich documentation
Multiple-channel community support

ACRN/RISC-V Architecture & Status



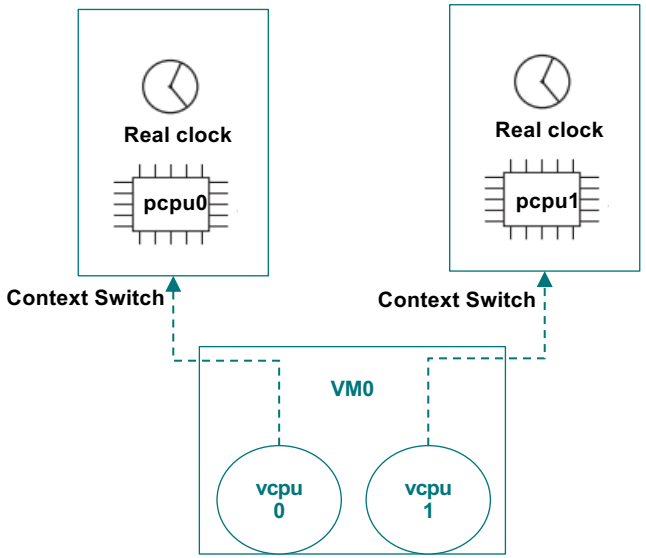
- ❑ **Host Management**
  - SMP Scheduler
  - Virtual Memory
  - Trap Handler
  - Debug Console
- ❑ **Guest Management**
  - CPU Virtualization
  - Memory Partitioning
  - IO Handling
  - IRQ Delivery
- ❑ **Device Model**
  - Hypervisor DM
  - *Virtio devices*
  - *Pass-thru devices*

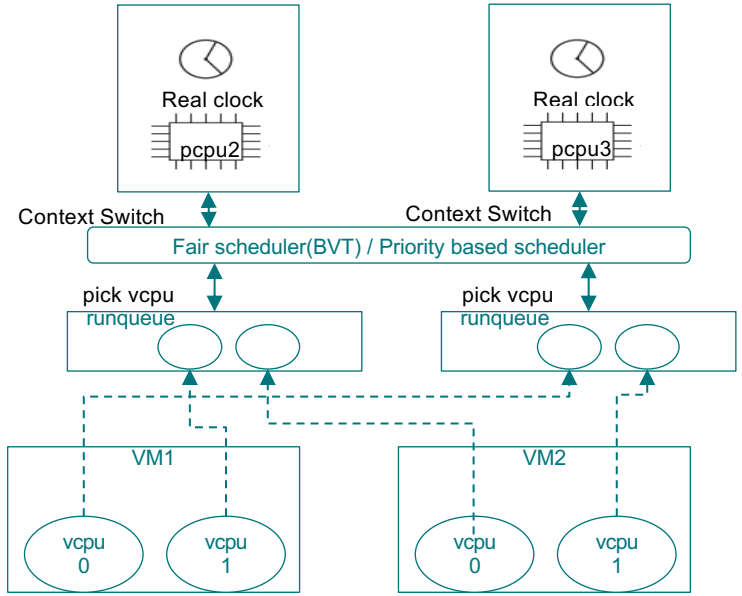
Ready

WIP

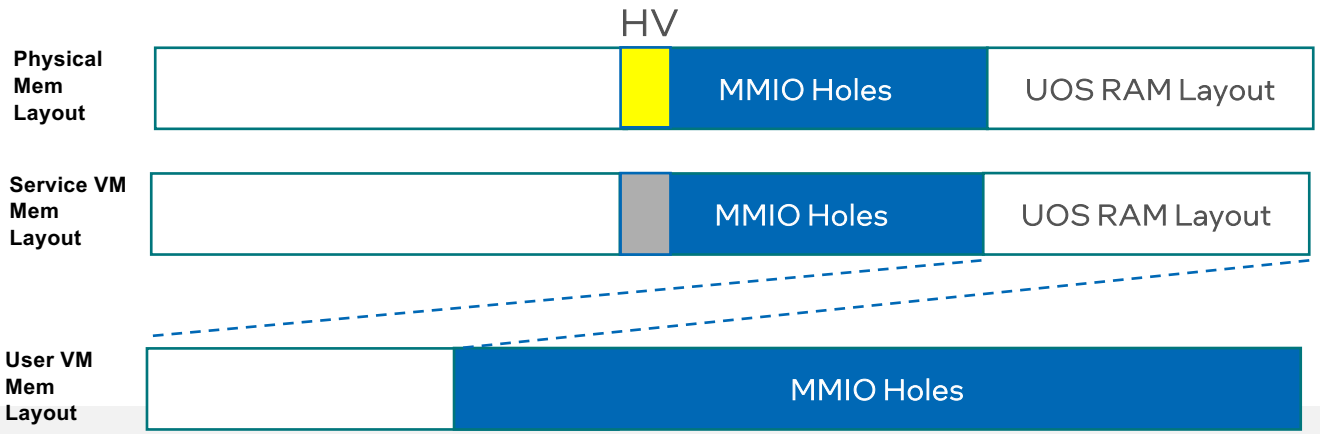
CPU Virtualization & Mem Partitioning

- CPU Virtualization
  - pCPU partitioning
  - pCPU sharing
  - PerCPU infra.

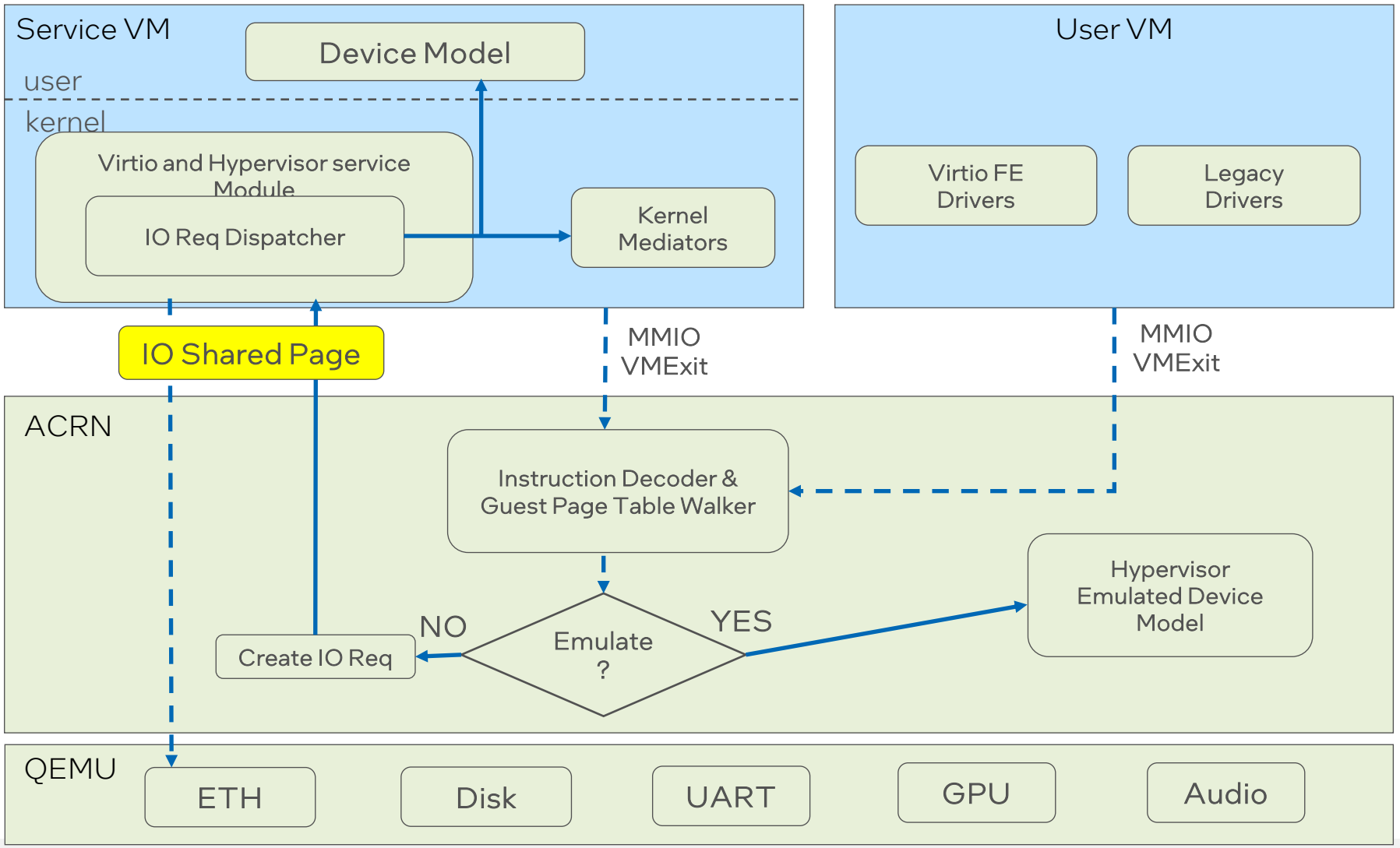




- Memory Partitioning
  - 2-stage address translation
  - VMExit infra.
  - *IOMMU*

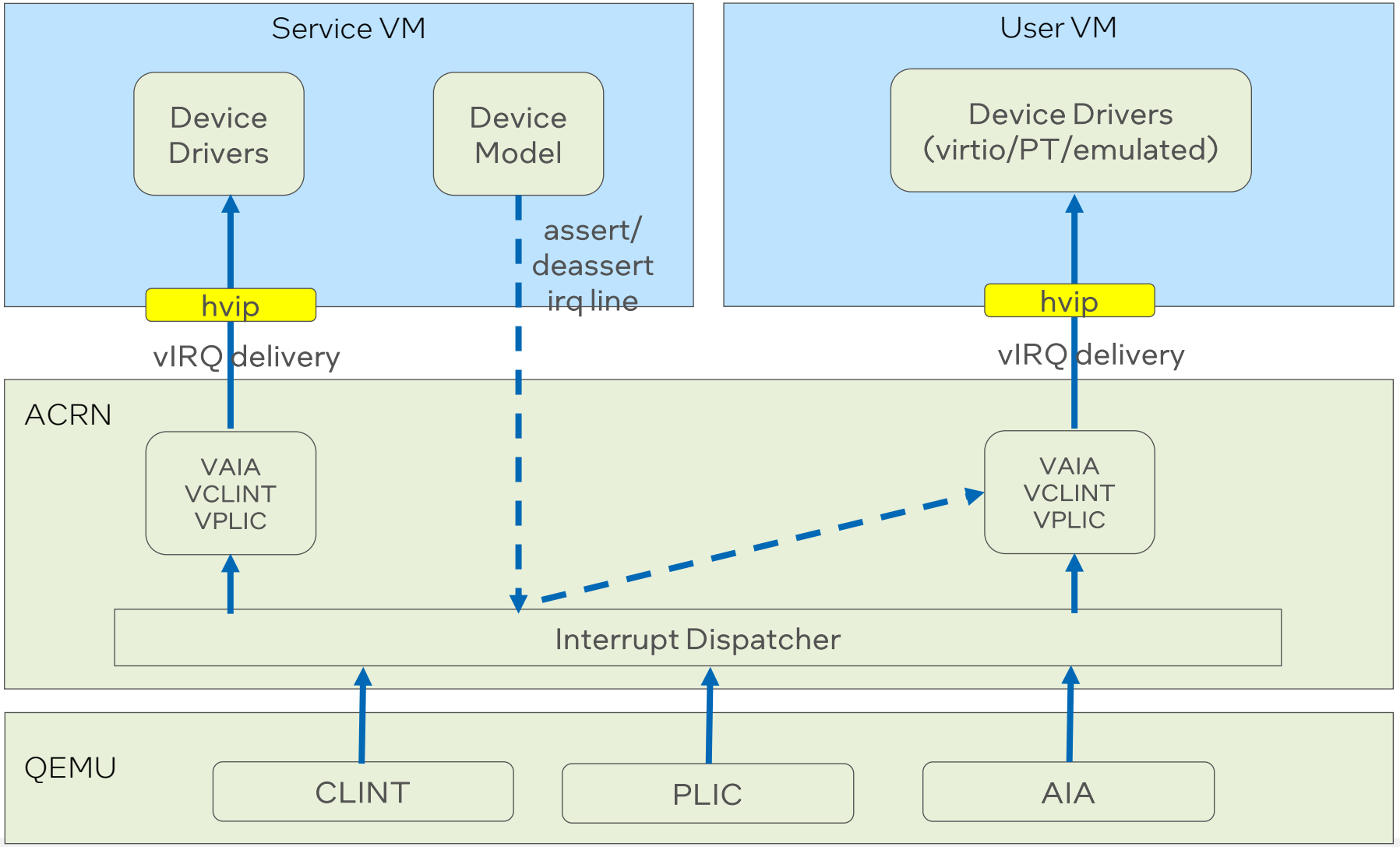


DM & IO Handling Flow



- ❑ IO Handling Flow
  - MMIO VMExit Handler
  - Instruction Emulator
  - IO Request Infra.
  - Virtio framework
- ❑ Device Model
  - Hypervisor DM
  - *Virtio devices*
  - *Pass-thru devices*

IRQ Delivery Flow



- Real HW IRQ
  - HV IRQ Dispatcher
  - IRQChip Emulation
  - vIRQ Injection
- Virtio vIRQ
  - VMCall Handling
  - IRQChip Emulation
  - vIRQ Injection

Call to Action

https://projectacrn.org

Join us!

If you support the ACRN project and feel that this is the right thing for the embedded ecosystem, join us in moving this project forward together as a community member.

We need code contributors, users, and project direction influencers!

Contribute code!

Make a difference to the project by committing code, help us become a better project.

Project code merged in the past 6 months allows you to become a voting member of the Technical Steering Committee.

All Contributions Matter

In open source projects a contribution can be anything which helps the project to accomplish its mission. Examples of Contributions beyond just code include:

Financial Assistance, Requirements Gathering, Documentation, Testing, Bug Reporting

Find more info of ACRN /RISC-V project

https://projectacrn.github.io/latest/projects/multi-arch-support.html#risc-v-support

- https://riseproject.dev

RISE is focused on positive and transparent collaborations with upstream projects to deliver commercial-ready software for various use cases

How: Align on highest priorities & avoid (accidental) duplication of work
Goal: Accelerate open source SW for RISC-V architecture

https://www.intel.com/content/www/us/en/developer/articles/community/rising-to-the-challenge-risc-v-software-readiness.html

Finding more interesting topics from Intel on RISC-V summit China 2023

Topic	When
RISC-V Vector Support on Valgrind	August 25 6pm
Best practice to optimize SW with vectorization on RISC-V	Poster
RISC-V firmware solution	August 24 4:30pm
Enhance UEFI on RISC-V	August 24 4:20pm
Enabling compliance test for RISC-V BRS	August 24 3pm
The ACRN/RISC-V project: embedded hypervisor design and status update	August 24 5pm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