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PROJECT OVERVIEW
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JOIN US!
Current State of Affairs – IoT Development

IoT device devices requires support for a myriad of HW resources on one platform:

Ex: Camera, Audio, Graphics, Networking, etc.

Needs to be able to support and run multiple operating systems simultaneously

Ex: Linux, Android, Windows, RTOS etc.

Needs to be able to support and run multiple SW tools and applications depending on the IoT device’s usage model

Need a way to consolidate ECUs and SW technology investment to lower total BOM costs for IoT devices productization
Virtualization is Key

Current Data Center Hypervisors

- Too large for embedded IoT development
- No safety-critical workload considerations
- Requires too much overhead for embedded development

Current Embedded Hypervisors

- Highly dependent on closed source proprietary solutions
- Expensive
- Makes product longevity difficult
- Hard partition, no ability to share resources

No Open Source Hypervisor solution currently exists that is optimized for embedded IoT development
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.
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<table>
<thead>
<tr>
<th>Project ACRN™ Pillars</th>
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<tbody>
<tr>
<td>Small footprint</td>
</tr>
<tr>
<td>• Optimized for resource constrained devices</td>
</tr>
<tr>
<td>• Few lines of code: Approx. only 27,000 vs. &lt;156K for datacenter-centric hypervisors</td>
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<tr>
<td>Built with Real Time in Mind</td>
</tr>
<tr>
<td>• Low latency</td>
</tr>
<tr>
<td>• Enables faster boot time</td>
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<tr>
<td>• Improves overall responsiveness with hardware communication</td>
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<tr>
<td>Built for Embedded IoT</td>
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<tr>
<td>• Virtualization beyond the “basics”</td>
</tr>
<tr>
<td>• Virtualization of Embedded IoT dev functions included</td>
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<tr>
<td>• Rich set of I/O mediators to share devices across multiple VMs</td>
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<tr>
<td>Safety Criticality</td>
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<tr>
<td>• Safety critical workloads have priority</td>
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<tr>
<td>• Isolates safety critical workloads</td>
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<tr>
<td>• Project is built with safety critical workload considerations in mind</td>
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<tr>
<td>Adaptability</td>
</tr>
<tr>
<td>• Multi-OS support for guest operating systems like Linux and Android</td>
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<tr>
<td>• Applicable across many use cases</td>
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<tr>
<td>Truly Open Source</td>
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<tr>
<td>• Scalable support</td>
</tr>
<tr>
<td>• Significant R&amp;D and development cost savings</td>
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<tr>
<td>• Code transparency</td>
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<tr>
<td>• SW development with industry leaders</td>
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<td>• Permissive BSD licensing</td>
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ACRN™ & OSV/ISV Vendors

**Project’s Goal**
Provide an embedded hypervisor reference solution to enable OSV/ISVs

A **transparent enabler** that provides:
- A **common architecture** to be used as-is
- A **high quality reference stack** optimized for embedded development

**Productize** on top of ACRN directly by **adding value** with:
- Proprietary Service OS or RTOS
- Commercial Licensing
- Commercial Support

Moving the industry towards faster overall product development
• Hypervisor sits right on top of bootloader for **fast booting** capabilities.

• **Partitioning of resources** to ensure safety-critical and non-safety critical domains are able to coexist on one SoC.

• **Rich IO mediators** that allow for the Service OS to communicate directly to SoC ensuring low latency for safety critical elements

• Allows for **multiple operating systems** to be supported by one SoC through efficient virtualization
ACRN™ Usage: Automotive Example

SAFETY CRITICAL DOMAIN

- Service OS (SOS)
  - Fastboot and Cluster Apps
  - Middleware & Frameworks
  - Linux | (RTOS)

- Warn/inform Safety (ADAS)
  - ADAS App
  - Middleware & Frameworks
  - Linux | (RTOS)
  - Cam Pipe
  - Computer Vision

- Device Model

- Kernel Mediators
  - IPU Mediation
  - GPU Mediation
  - Audio DSP Mediation

NON-SAFETY CRITICAL DOMAIN

- Infotainment (IVI)
  - Infotainment Apps
  - Middleware & Frameworks
  - Linux | Android
  - Cam Pipe
  - Graphics & Video
  - Audio

- Rear Seat Entertainment (RSE)
  - Infotainment Apps
  - Middleware & Frameworks
  - Linux | Android
  - Graphics & Video
  - Audio

- Hypervisor

- Bootloader

- SoC
Current Project Status

**Code**
- Support for hypervisor and device model included
- Support for Storage, Network and Console Mediators
- Integration with a Linux-derivative Service OS in progress
- Currently supporting the Intel Apollo Lake NUC platforms
- Project code will be posted on public GitHub on March 13th, 2018

**Documentation**
- All project documentation including release notes, API documentation and all other documentation related to the code will be available on project GitHub by March 13th, 2018
- Other documentation planned include, a Getting Started Guide to familiarize the developer with the project
- A Contribution guide to encourage code contributions to the project, etc.

**CI**
- Currently utilizing Intel CI processes to open source the project.
- Planned collaboration with the open source community on input for CI infrastructure for the project to a neutral host site

**On the Horizon**
- Mediator Support for Audio, IPU, GFx, CSE, TSN etc. planned for expanded embedded IoT use cases of the project
- Create a process to address functional safety (FuSa) and security requirements together with the project community
- Hardware platform support to create a hardware agonistic project

ACRN™
Governance Ethos

Community Involved
• Encourage and welcome participation in the project

Transparency
• Committed to working transparently in the open to encourage the open source community’s involvement

Code > Currency
• The project is committed to a true open governance where code contributions is the main objective
Initial appointments by founding contributors

Election amongst contributors every 6 months (after launch). After the first election, each member is elected for one year

Qualified voters have code merged in the past 6 months

Voting Members

- Most active commits, driving decisions for the project, leadership and point of contact
- Have the ability to merge code (+2)
- Ability to nominate new maintainer roles to be voted on as needed

Chair/Maintainer

Voted on by members

Committee will have (5) members at project launch.

No more than 50% of members from one company or organization

Committee will always have an odd number of members to allow for voting decisions

Technical Steering Committee

Technical Steering Committee

Assigned through meritocracy

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Project ACRN™
For Embedded Developers

• Build complex embedded systems requiring various levels of safety-criticality

• Resource sharing allows for maximizing potential of resource-constrained devices while ensuring safety critical workloads are given priority to platform hardware

• Open source code allows for developmental cost savings as transparent code ensures code compatibility, flexibility in vendor selection as well as helping to ensure longevity of product lifecycle while reducing support and maintenance costs of the product’s life.

• Small footprint, lightweight code base to ensure inclusion of only necessary code optimized for embedded development. No superfluous code.
Endorse us!
If you support the ACRN project and feel that this is the right thing for the embedded ecosystem.
No sponsorship dollars required
Add your company’s name, logo and a quote to our project announcement press release on March 12th, 2018

Contribute code!
Make a difference to the project by committing code, help us become a better project.
Join in and participate in the project to become a member of the Technical Steering Committee

Call to Action
# Project Opening Plan

<table>
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<tr>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
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<tr>
<td><strong>ELC North America March 12-14</strong></td>
<td></td>
<td><strong>July XX, 2018</strong></td>
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- Keynote on March 13th announce project with at least 1 automotive partner and endorsements from early adopters
- Project will be hosted by Linux Foundation. Press release by Linux Foundation to announce project
- Demo and Session at conference with project
- Open source project via GitHub
- Neutral, open source project name
- Website

- Beta features of project are available
- Press release to announce the partners that signed on to the project and to announce the β features release of the project
- Fully formalize TSC with voting members via meritocracy

Continue to build Project momentum
SAFETY/SECURITY CRITICAL DOMAIN

Service OS (SOS)

Apps

Device Model

Middleware & Frameworks

Linux | (RTOS)

Kernel Mediators

- IPU Mediation
- GPU Mediation
- Audio DSP Mediation

VM 1

Apps

Middleware & Frameworks

Linux | (RTOS)

Graphics & Video

Computer Vision

Hypervisor

Bootloader

SoC

VM 2

Apps

Middleware & Frameworks

Windows | Android

Graphics & Video

Audio

NON-SAFETY CRITICAL DOMAIN

VM 3

Apps

Middleware & Frameworks

Linux | (RTOS)

Graphics & Video

Audio

ACRN

Device Model

Middleware & Frameworks

Linux | (RTOS)

Graphics & Video

Computer Vision

Hypervisor

Bootloader

SoC

ACRN