Workload Consolidation with ACRN™ Hypervisor

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Agenda

• ACRN Based Reference Stack for Workload Consolidation
• ACRN Update: 1.0 Release and 2.0 Roadmap
• Introduction of Celadon – Open Source Android Stack for IA
Overview of Workload Consolidation

Modern OS -> Multiple App/Process

Linux Container -> Multiple Linux based System

Kata Container -> Hardware Backed Security

KVM, XEN -> Different OS

Why ACRN ->
Heterogeneous Workload Consolidation
Functional Safe World and Non-Safe World
Hard Real Time and Rich Graphics
Open Source Fusion Stack from Intel

- Service OS: Clear Linux*
- Safety Critical RTOS: Zephyr™ (ISO 26262 ASIL D)
- Guest Operating Systems: Celadon

Functionally Safe and Real Time Capable Hypervisor (ISO 26262 ASIL D)

Intel Hardware

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Clear Linux* OS is an open source, rolling release Linux distribution optimized for performance and security, from the Cloud to the Edge, designed for customization, and manageability.

The Zephyr™ Project is a scalable real-time operating system (RTOS) supporting multiple hardware architectures, optimized for resource constrained devices, and built with safety and security in mind.

Celadon is an open source Android* software reference stack for Intel architecture. It builds upon a vanilla Android stack and incorporates open sourced components that are optimized for the hardware.

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.
Usage Example – In-Vehicle Experience

- Safety OS
- Cluster
- ADAS Info
- Infotainment (IVI)

ACRN Hypervisor

Bootloader

SoC
Neusoft Automotive C4-Alfus Pro System

Cluster
- Traditional Cluster
- Safety Alert

IVI – Up Screen
- Focus on display to driver
- ADAS Display

IVI – Bottom Screen
- Focus on operation
- Voice control

Passenger Screen (option)
- Assist driver on complex operation
- Entertainment
Neusoft C4-Alfus Pro Hardware Architecture

C4-Alfus H.U.

**SOC-Intel GR**
- 4 Cores
- 1.8 GHz
- 4G DDR
- 64G EMMC

**MCU-Renesas RH850**
- 80 MHz
- 64K RAM
- 768K ROM
Usage Example – Industry

PLC Consolidation Use-Case
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Introduction

ACRN™ is a flexible, open-source, lightweight hypervisor - intended to enable consolidation of heterogeneous workloads, and to streamline IoT edge development.

- A Linux Foundation Project Launched in March 2018
- Version 1.0 released in May 2019

https://projectacrn.org
ACRN Value Proposition

**Small Footprint**
- Optimized for IOT class solutions
- Significantly smaller footprint than cloud/data center targeted hypervisors

**Functional Safety and Hard Real time**
- Heterogeneous Workload Consolidation
- Real time & HMI
- Functional Safety & Unsafe

**Open-source with Flexible Licensing**
- BSD license enables proprietary Guest OS
- True Open source with a vibrant Community

ACRN reduces system deployment complexity, enables heterogeneous architectures, and provide TCO advantages
ACRN 1.0

Main Usage: In-Vehicle Experience

- VM1: Service OS + Cluster
- VM2: User VMs
- VM3
- VM4

Ready for Production
- Fast Boot and Performance KPI
- 100% CTS Pass for Android Guest

Key Features
- Safety and Security Isolation (Cluster + IVI)
- Extensive Sharing Capabilities
- Multiple OS Support
- MISRA-C Compliance

Released in May 2019 @github.com/projectacrn/
Looking Forward – ACRN 2.0

Hybrid-Mode
- Partition + Shared

VM Type
- Safety VM
- Real-time VM

Kata Container & CPU sharing

More OS Support:
- Zephyr, VxWorks, RT-Linux, Windows

FUSA Certification
Foundational Characteristics

❖ Heterogeneous Workloads consolidation
❖ Small Footprint (sub-50K lines)
❖ Open-source with a flexible licensing (BSD)
❖ Shared & Partitioned frameworks
❖ Beyond-Compute (IOs, Accelerators, Graphics/Media sharing)
❖ Designed for IOT market (Industrial, Automotive and beyond)

TODAY: ADVANCED SHARING

• Linux based Open source Service OS
• Linux, Android Guest OS’s
• Multiple Guest VMs in Sharing Mode
• Sharing of various IO’s

SECURE CONTAINERS

• Kata Containers as VMs
• Kubernetes support for Kata

DEEP ISOLATION

• Partition mode
• Open source Zephyr RTOS in Partition mode

GUEST OS EXPANSION

• Microsoft Windows
• Celadon – Open source Android
• Automotive Grade Linux
• Wind River VxWorks
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Celadon
an Android* open source platform for Intel® architecture.

SMART CITIES

AUTOMOTIVE

RETAIL

SMART HOME

Android* on IA that just works
CELADON is an Android* open source platform for Intel® architecture.

- **ACCELERATE DEVELOPMENT**
  - Open platform enablement speeds build time, lowering time to market

- **DEVELOP ON LATEST ANDROID* RELEASES**

- **IMPROVE EFFICIENCY**
  - Leverage Intel® hardware acceleration

- **LEVERAGE INTEL® HARDWARE ACCELERATION**

- **SCALE RELIABLY**
  - Retail, Automotive, Smart Home

- **SHIFT & EVOLVE DEPLOYMENTS**
ACCELERATE DEVELOPMENT with CELADON

IA Ready
- open platform enabling/adaptable
- helps developers speed Time to Market (TTM)
- across a variety of segments

Optimized
- supports a wide range of hardware components enhanced for Intel® architecture making it easy for rapid prototyping and building new applications

Verified
- full compatibility is verified using the Android* Compatibility Test Suite (CTS), ensuring consistent experiences across application and hardware environments

Refreshed
- continued upgrades & security mitigations provide opportunities to realize and scale new features when developing on the latest Android* dessert
Project Celadon

Delivery Model

Google Android
Android Open Source Project (AOSP)
Android Runtime (ART)
Latest Android Dessert

Intel Patches
Intel Board Support Package
Intel® Architecture Support
Fully Automated Operations
Cross Test Suite Compliant

Product Quality Software
Special Feature Access
**Fast Boot, Hibernation**
Machine Learning...

open platform enabling
helps developers speed
Time to Market (TTM)
across a variety of segments
Celedon Demos

Intel NUC NUC7i5DNHE (Intel CORE)

Intel NUC NUC6CAYH (Intel ATOM)
**IMPROVE EFFICIENCY with ** INTEL® HARDWARE **

**LEVERAGE HARDWARE ACCELERATION**

**Intel® Accelerators & Differentiators**
- Intel® Optane
- OpenVino + MyriadX
- OpenVino + Movidius
- RealSense Depth Camera
- OpenVino + MKL-DNN
- Intel® Active Management Technology

**Intel® Processor Family**
- Kaby Lake
- Apollo Lake

**Functionality**
- Dual Audio & Playback
- Machine Learning with Movidius
- Dual Video & Display
- Accelerated Graphics
- Vehicle Hardware Abstraction Layer Emulator
- Security
- Android* swap w/ Optane
- Remote Manageability
- Exterior View
- Quick Boot
- Hibernation
- Fast Boot over USB debug capability (DbC)

**Dessert P**
REGULARLY REFRESHED UPGRADES

**Dessert Q**

**Dessert R**
SCALE RELIABLY ACROSS NEW MARKETS

RETAIL
- Personalized Shopping Experiences
- Inventory Management
- Precision Marketing
- In-store Path to Purchase

AUTOMOTIVE
- In-Vehicle Infotainment
- Enhanced Diagnostics
- Maintenance & Safety
- Vehicular Interaction

EDGE
- Advanced Analytics
- Workload Consolidation
- Security & Manageability

SMART CITIES
- Safety & Security
- Resident Engagement
- Smart Parking
- Traffic Flow Monitoring

CLOUD GAMING
- High Performance Gaming
- Social Identity Mapping
- AI & Graphics
- Interactive Lobby

PROJECT CELADON + DEVELOPER COMMUNITY ENABLES INNOVATION
CELADON USE CASES
CELADON RETAIL USAGE CASE
DIGITAL SIGNAGE

CHALLENGES
Provide flexible Android OS implementations on performant hardware

Bring lower cost devices to large digital signage applications at rapid speeds

Provide security & support to innovative visual messaging

LEVERAGE INTEL HARDWARE

INTEL SOFTWARE
Project Celadon

INTEL HARDWARE
Apollo Lake Processor

"Project Celadon allowed us to focus on building our portion of a solution for our customers. Previously, I would have needed a significant budget for BSP and other hardware related tasks before even being close to building a product."

- Customer Testimonial
CELADON RETAIL USAGE CASE
SMART TERMINAL

CHALLENGE
Rapid Segment Scaling
Quickly develop IoT applications for security & facial authentication at smart terminals

SOLUTION
Smart Terminal

ACCELERATE DEVELOPMENT
Using AI and wireless technology, achieve real time security with 99.8% accuracy in face recognition with Project Celadon
CHALLENGE
Innovative Automotive Applications

SOLUTION

INTEL® HARDWARE
Atom A3900 Processor

INTEL® SOFTWARE
Project Celadon
Gordon Ridge Dev Kit

SHIFT & EVOLVE DEPLOYMENTS
Tier1s and Car OEMs can start their product development with Celadon on a standard Intel NUC HW platform, then shift the SW stack to Intel's Automotive Platform, Gordon Ridge MRB developer kit.
HOW DO I CONTRIBUTE TO THE CELADON COMMUNITY?

Visit our Guides and Tutorials https://01.org/projectceladon/documentation

Celadon is an open source Android software reference stack for the Android community to bring ideas to life while developing on the latest Android release and the latest Intel hardware platforms.

Profiling System Power Consumption on Celadon using Intel® SoC Watch
Overview: Intel® SoC Watch is a command line tool for monitoring system power consumption on Intel platforms. The tool monitors active and low power states re...

Build Celadon from source
System requirements: Though Android is typically built with a GNU/Linux or Mac OS operating system, we recommend you build the Celadon images on a 64-bit deve...
Learn More

https://01.org/projectceladon
https://github.com/projectceladon
FAQ

Win Customers

Determine if Android* on Intel architecture is a good fit for your customers

Suggest Project Celadon for customer product POC use

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https://lists.01.org/mailman/listinfo/celadon
THANK YOU!