



# The Automotive Virtual Platform

The automotive virtual platform COQOS Hypervisor SDK is a modular software kit for developing cockpit controllers, rear-seat entertainment solutions, telematics systems, gateways and domain controllers. The SDK implements a large array of features from the virtualization standard VIRTIO, creating maximum flexibility: guest operating systems can be used and reused on different System-on-Chips. Its architecture makes it possible to run several separated virtual machines (VMs) on a single processor, integrating real-time operating systems, open source systems like Linux or Android and AUTOSAR (both Classic and Adaptive).

### Target Automotive ECU

- Cockpit controller
- Rear-seat entertainment
- Telematics systems
- Advanced gateway
- Domain controller

### Main Features

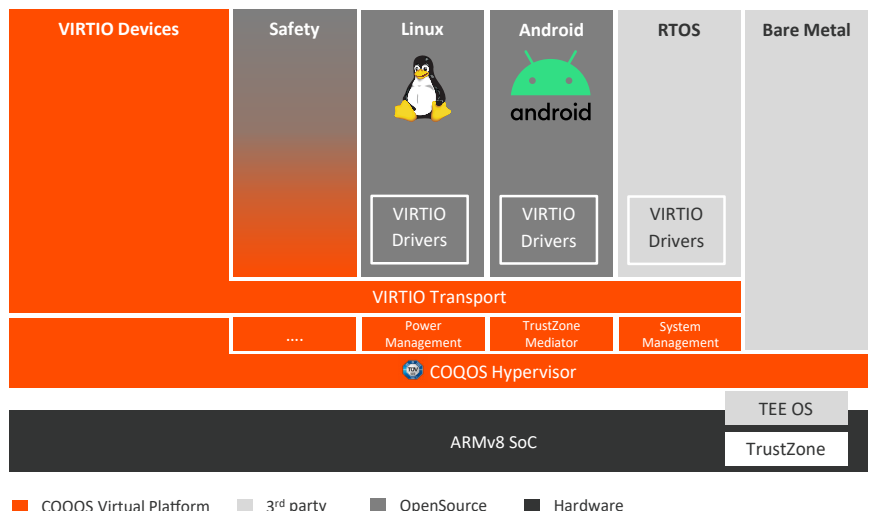
- Safe partitioning of the processor
- Freedom from interference between VM's
- Runs with any OS that supports VIRTIO
- Extension for improved safety and security
- Multiple operating systems on a singlecore or multicore CPU
- VIRTIO-based virtualization incl. multimedia devices
- Support of hardware virtualization
- Suspend-to-RAM
- Trustzone Mediator

### Properties

- Includes the most advanced VIRTIO devices (upcoming VIRTIO version)
- Runs out of the box with any OS that supports VIRTIO (e.g. Android™, AGL)
- Hypervisor ISO-26262 certified as Safety Element out of Context (SEooC) up to ASIL-B
- Power management and Suspend-to-RAM
- Trustzone mediator restricts access to select VMs to ensure security
- Familiar integration debugging and tracing tools (e.g. Yocto, Android Debug Bridge, etc.)

### Benefits

- Reduces hardware costs (HW consolidation)
- Safely consolidates mixed critical functions (QM and ASIL)
- Eliminates vendor lock-in and minimizes development effort/time to market thanks to open standard VIRTIO
- Enables reuse of software
- Allows easy software update
- Increases security (small attack surface thanks to lean Type 1 hypervisor)



## Specifications

### Reference SoC

- Qualcomm® Snapdragon™ SA 8155P and SA6155P

### Supported SoCs with essential features

- NXP® i.MX 8
- NXP® S32G
- Renesas R-Car H3/M3
- Samsung Exynos V910
- TI Jacinto™ 7
- Any other ARMv8-A SoC can be supported on customer request

### COQOS Hypervisor

- Type-1 hypervisor runs directly on the host's hardware to control the hardware and to manage guest operating systems
- Supports hardware virtualization
- Resource visibility based on static configuration
- Smaller attack surface due to lean codebase
- Tracing Framework where extracted traces can either be analyzed manually or using an analysis/visualization tool

### ISO 26262

TÜV SÜD certified COQOS Hypervisor to ISO 26262:2018 ASIL-B as Safety Element out of Context (SEooC).

### VIRTIO Devices

OpenSynergy supports a wide range of virtualized devices and continuously contributes to standardization and open source. Current list of VIRTIO devices in the SDK:

- **VIRTIO-blk** (Block device): for mass storage
- **VIRTIO-rpmb** (replay protected memory block): reserved section of the block device that only allows restricted operations from guests.
- **VIRTIO-rng** (random number generator): hardware component that generates random numbers used e.g., for cryptographic functions.
- **VIRTIO-vssock** (virtual socket): interface that provides a point-to-point connection between two virtual machines.
- **VIRTIO-gpu**: enables graphical output of VMs with different requirements on one or multiple displays (Shared Display) and for paravirtualization of the 3D GPU (Shared GPU)
- **VIRTIO-video** (decode): support for hardware assisted video playback in Android of H.264 encoded videos
- **VIRTIO-snd** (sound): acts like a virtual audio cable between different VMs.
- **VIRTIO-input**: shares input e.g. for touch
- **VIRTIO-console**: shares a console (command line interface) from a single virtual machine to other virtual machines.
- **VIRTIO-scmi** (System Control and Management Interface): Virtualization of the ARM SCMI standard for seamless pass-through and accessing local sensors such as the gyroscope and accelerometer.

- **VIRTIO-net** (Network) for paravirtual ethernet + Virtual Character Driver (VCHAR)

### Modular and managed boot

- Bootsystem image is split to smaller HV and VM images
- Allows to change the boot sequence of the different virtual machines (VMs)
- Allows shutdown and restart of a single virtual machine

### Power management

COQOS Hypervisor SDK supports the Arm PSCI specification, all mandatory PSCI calls and those used by the Linux kernel.

### Suspend-to-RAM

Suspend-to-RAM orchestrates suspending into a low power consumption mode (= stop execution of OS and put execution state into RAM) of all guest VMs and the whole system (including devices). Reduces energy consumption and enables quick return to the state prior to suspension.

### TrustZone Mediator

TrustZone allows secure functions e.g., hardware keymaster or playback of digitally protected content. TrustZone mediator allows the communication between VMs and ARM TrustZone. It guarantees secure access to TrustZone by multiple VMs and/or restricts access to TrustZone as per configuration.

### SMMU Support

The hypervisor support ARM's SMMUs (System Memory Management Units), which will prevent platform devices from reading or corrupting memory of virtual machines (DMA attack).

### Support for Unikraft

Instructions how to deploy the minimalistic library Unikraft onto COQOS Hypervisor SDK. In conjunction with the COQOS, Unikraft is an ideal solution for isolating individual applications into virtual machines, guaranteeing freedom of interference between the applications.

### Android, Linux and RTOS

COQOS Hypervisor SDK supports the following guest OSs:

- Latest Linux versions
- Latest Android versions
- OpenSynergy supports out-of-box usage of FreeRTOS.

based on customer needs any OS that runs on the hardware can be supported.

## Development Environment

### Hypervisor Configuration

COQOS configuration tooling generates the hypervisor configuration from a model described in XML.

### Build and Integrate

OpenSynergy delivers COQOS Hypervisor SDK as a Yocto "meta-layer". Yocto is a popular open source Yocto toolchain.

### Test and Debug

- Periscope: monitor the hypervisor and individual guests over a single physical serial link
- Use ADB (Android Debug Bridge) on multiple guests via a single USB port
- Extensive tracing support with time-stamp synchronisation to tracking down difficult issues
- Use guest tooling such as GDB as in a non-virtual environment

### CHRONview

Trace Visualization using Inchron CHRONView allows for time correlated visualization VM and Hypervisor states.

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