

Company Overview





Mixed-Critical Virtualization in Embedded Systems done right

Virtual Open Systems: Profile

- Virtual Open Systems (VOSyS) is a French fully independent & private software company created and operating since Jan 2011:
 - self-sustained, profitable
 - share capital of 505 400€, no debts
- The core activity is about design and implementation of high-performance mixed-critical virtualization solutions on low-power multi-core & heterogeneous platforms:
 - VOSyS has been the first company to port KVM on ARM in collaboration with Columbia University
 - VOSyS created and is leading the Automotive Grade Linux Virtualization Expert Group
- Operating in market vertical segments requiring virtualization technologies addressing mixedcriticality:
 - Automotive, Industrial, IoT-Edge Computing, energy Power-Breakers, Drones, NFV, ..





Foundation company statements

- Mission Enable customers to gain competitive advantage
- Values Believe in open source, industry standards, Customer satisfaction
- Vision Become worldwide leader in mixed critical virtualization and accelerators virtualization
- Strategy Continuous re-inforcement of activity for competitive mixed-critical virtualization hardware/software solutions in Safety-aware Automotive, IoT edge



International Exposure

- Involvement in several software open source projects:
 - Linux kernel, PSCI, VFIO
 - KVM, QEMU, mttcg, eventfd, LibVirt, VirtIO
 - vhost-user, Snabb
 - OpenStack, OPNFV
 - AGL EG-Virt



- Partner in EU funded research & innovation projects
- Membership in international initiatives
- Several scientific papers & international events dissemination
- ➢ 5 filed patents in US, EU

Virtual Open Systems: research projects



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Papers Dissemination



Virtual Open Systems constantly disseminates its results through scientific publications at international conferences; it counts more than **40 publications**, of which the most recent:

- Cloud and Edge Trusted Virtualized Infrastructure Manager (VIM) Security and Trust in OpenStack WCNC2019
- VOSYSVirtualNet: Efficient Inter-world Network Channel for Mixed-Criticality Systems, SIES2018
- The Next Generation Platform as a Service, Cloudifying Service Deployments in Telco-Operators Infrastructure, ICT2018
- FPGA virtualization with accelerators overcommitment for Network Function Virtualization, Reconfig17
- Paving the way towards a highly energy-efficient and highly integrated compute node for the Exascale revolution: the ExaNoDe approach, **DSD2017**
- Lightweight and Generic RDMA Engine Para-Virtualization for the KVM Hypervisor, HPCS2017
- VOSYSmonitor, a Low Latency Monitor Layer for Mixed-Criticality Systems on ARMv8-A, ECRTS2017





IP protection is a strategic investment at Virtual Open Systems. To date 5 patents:

- Compute node supporting virtual machine and services (US grant, EU exam.)
 - A computing system able to accelerate multiple OSes in a mixed criticality environment, enabling IVI and Cluster coexistence in a single HW platform
- Virtualization manager for reconfigurable hardware accelerators (US/EU exam.)
 - HW IP enabling FPGA accelerators virtualization in a smart re-configurable, orchestrated manner for computer vision, networking and ADAS applications
- Interrupt controller for mixed criticality virtual machines (US grant, EU exam.)
 - ARMv8 Interrupt controller designed to improve performance and reduce interrupt latency in mixed critical and virtualized environments (e.g., automotive, industrial ..)
- vSwitch for multi compartment mixed critical network communication (US/ EU grant)
 - Accelerated virtual switch infrastructure for accelerated compute node OSes with mixed levels of criticality. It enables high performance and secure communication between different critical worlds
- Disaggregated Computing Architecture (in embargo period)





Innovation & International Visibility

Innovation, open source and international exposure drives the company Services

Custom Design & Development services

- The company provides services in the virtualization domain on an international landscape to serve customers in different market segments
- Market segments includes telecommunications, networking, mixed-critical systems (e.g., energy power breaker, industrial, automotive, etc.)
- Customers include first tier companies from EU, Far-East, North America

Virtualization Know-how Productization

The acquired know-how in virtualization is being used by the Company to develop its own Virtualization product roadmap, to serve mixedcritical market segment (with VOSySmonitor, VOSySmcs, VOSySiot) and NFV networking systems (VOSySwitch)



- With major outcome as open source contributions
 - KVM on ARM => Paving the way towards virtualization in embedded systems
 - KVM and VCPU Hotplug for ARMv8 => Better resource utilization in the Virtual Machines
 - VFIO, IOMMU for ARMv7/8 => Support for device passthrough in Linux
 - Support of the VFIO framework on QEMU => Support for device pass-through in QEMU
 - RFC for QEMU infrastructure for ACPI and VFIO => Emulation of ARMv8 servers
 - Multithreaded TCG, atomic instruction emulation => Real multicore virtual machine emulation
 - Vhost-user => fast networking switches

Virtual Open Systems: Track Record Industrial Product Engineering

- Energy management top-player customer cases:
 - VOSySmonitor **designed-win** in several customer products
 - Development of firmware management layer for low/medium voltage power breakers based on VOSySmonitor



 Development of custom firmwares for Renesas RZ-N1D and Altera Cyclone V based on VOSySmonitor



Altera Cyclone-V



Renesas RZ-N1D

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Virtual Open Systems: Track Record Automotive Product Engineering

- Automotive top-player customer cases:
 - VOSySmonitor product designed-in at several Tier-1 customers
 - Development of custom firmware for Renesas R-Car H3/M3, Xilinx UltraScale+ MPSoC, Nvidia Jetson TX1, Mediatek MT2712 based on VOSySmonitor



Xilinx MPSoC US+



Mediatek MT2712



Renesas R-Car H3



Nvidia Jetson TX1

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Virtual Open Systems: Track Record Virtualized access to custom IPs

- Innovative solutions in cloud and consumer cases:
 - Full design and implementation of **API remoting** solutions for **cloud servers** integrating innovative optical accelerators
 - OpenGLv2 API remoting: Full 3D acceleration within virtual machines on Odroid ARM





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Virtual Open Systems: Track Record High performance virtualization designs

- Design and development of custom pass-through solutions of multimedia, graphics and networking devices for Set-Top box
 - Full 3D acceleration, 4K video playback and display management inside virtual machines



4K Playback inside VMs



Telechips TCC8995

Virtual Open Systems: Track Record Emulation of custom Plateforms & OSs

Development services for custom KVM extensions to run bare-metal firmwares in QEMU virtual machines on Nvidia Jetson TX1 and TX2 boards



Nvidia Jetson TX1



Nvidia Jetson TX2





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VOSySmonitor is an **ISO-26262 ASIL-C certified** TrustZone based virtualization layer, to maximize safety with dedicated features in strictly isolated system architecture, thus guaranteeing best in class protection for the satefy critical domain:

- A superior isolation building on top of ARM hw trustzone
- Better latency performance while serving RTOS tasks (no context switch over-head)
- Power management support
- Scaleability to better support to increasingly complex use cases (only pay-for-whatcustomer-uses)



VOSYSmonitor

Virtual Open Systems: AGL EG-Virt

The Company is active on AGL, which aims to build a **complete open source SW stack for automotive**. AGL shares components with the GENIVI Development Platform, but it is focused on development and testing

- 100+ companies are part of AGL: Mercedes-Benz, Toyota, Nissan, Denso, Continental, Qualcomm, Panasonic, Renesas, etc.
- Virtual Open Systems has started and is leading the AGL Virtualization Expert Group (AGL EG-Virt):
 - Development, testing and documentation to enable open source virtualization
 - Defining plans and objectives through bi-weekly meeting with the community and presentations at international AGL events
 - Coordinated the work for the **first white paper** of the community presented at the AGL ALS meeting in Tokyo in June 2018



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Virtual Open Systems product: VOSYS

VOSySiot is an end-to-end IoT software stack product that enable mixed criticality applications to be run in IoT gateways:

Strong Security

- Trusted Computing
- Remote attestation and authentication supported
- Linux kernel integrity check

> Mixed criticality

Real time workloads to control actuators

Use cases are: Small office Home office (SOHO), Industry 4.0, Cyber Physical Systems, healthcare, etc.



VOSyS Cloud & Edge Trusted VIM

Adding security and trust into the virtualized infrastructure

- Enhanced security, hosts attestation and sensitive data protection
- Normal vs Secure World: an isolation at the hardware level by leveraging VOSySmonitor and ARM TrustZone
- VOSyS Trusted Open Stack Extensions: attestation services running in the Normal World
- VOSyS Security Services: executed inside a Trusted Execution Environment (TEE)



Use cases are: **smart cities, healthcare, edge computing, NFV,** etc.



vFPGA manager is an FPGA virtualization framework designed for virtual machines, containers and unikernels:



- Enables high performance direct communication between the VMs and accelerators
- Supports FPGA overcommitment (a single accelerator can be shared between multiple gusts for better efficiency)
- Supports existing VM and hardware accelerators

Use cases: Cloud computing (OpenStack), NFV, AI, Industry 4.0



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