



Xen Automotive Hypervisor

Automotive Linux Summit

1-2 July, Tokyo

Vehicles are Changing

- Vehicle became the “ultimate mobile device” and we, the people, are becoming “connected drivers”

“Connected Driver” Requirements

Look and Feel customization



Connected Car Services



3rd Party Applications



Quick development cycle



“Ultimate mobile device” requirements

**Stability &
Reliability**



Boot Time



Security



Virtualization

Why Xen?

- Type 1 Hypervisor
- Flexible Virtualization Mode
- Driver disaggregation
- ARM support
- Open Source, part of LF
- ~ 90k lines of code
- Mature since 2003 in general computing



Xen in Embedded

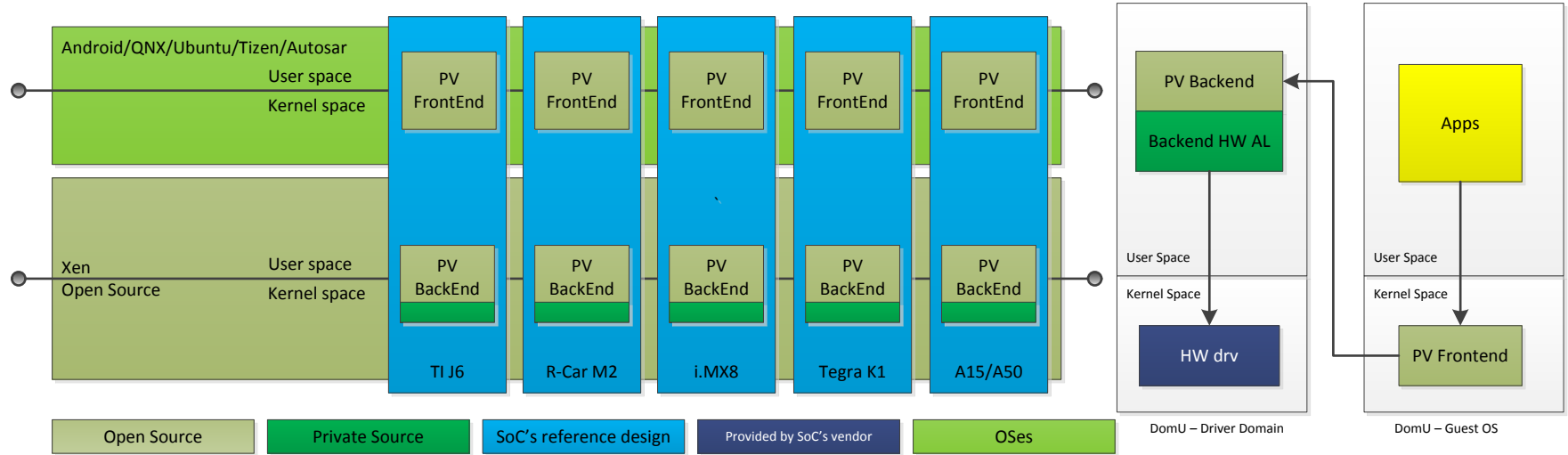
- With ARM support Xen is perfectly fit for embedded applications
- Experimental PV ARM support on Nvidia made by Samsung
- ARM HW virtualization support from Xen 4.3
- Added:
 - Interrupts mapping to DomU (for driver domains)
 - IOMEM mapping to DomU (for driver domains)
 - MMU SPT protection
 - PV drivers: HID, Audio, Framebuffer, etc.
 - Better DT support
- TODO:
 - RT scheduler improvements
 - More PV drivers (QNX)
 - Debug, fix, stabilize...

Peripherals sharing

Sharing of peripherals is implemented using PVHVM model (Paravirtualized devices on the host, running in HVM mode), zero-copy

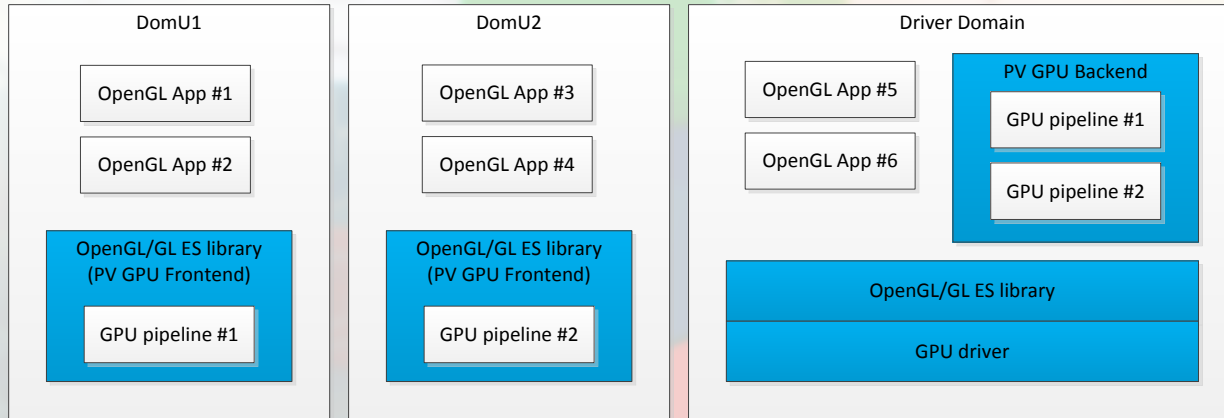
- Filesystem partitions
 - Standard Xen PV driver
- Network
 - Standard Xen PV driver
- USB
 - Based on old Xen 3.4 PV USB driver with major fixes
- HID (touchscreen)
 - NEW: kernelspace frontend and userspace backend, can be used for any type of events
- Audio
 - NEW: kernelspace frontend and userspace backend, based on ALSA
- Framebuffer
 - NEW: kernelspace frontend and userspace backend, deliver 60 FPS on J6
- GPU – in progress based on OpenGL/ES abstraction (HW independent)
- TODO:
 - GPS, Sensors

Ownership unbundling



- Xen Hypervisor – open source license
- Core PV Drivers – open source license
- PV Backend HW AL – private source license

GPU Virtualization

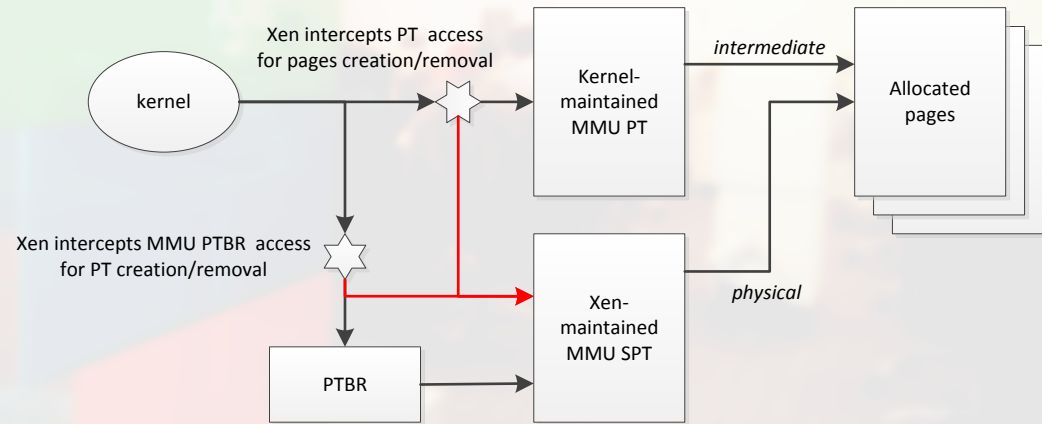


* using ClusterGL or VirtualGL

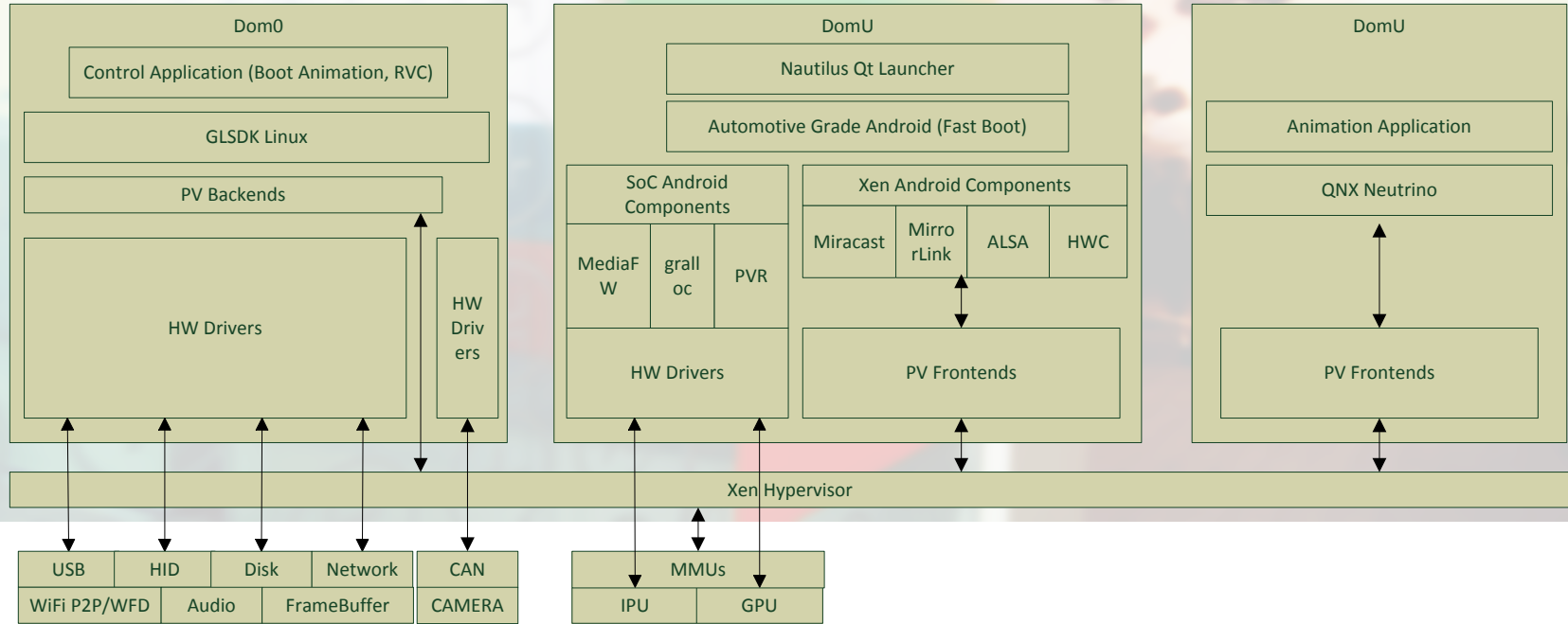
GL MMU SPT Approach – upstreamed

GL MMU SPT Approach

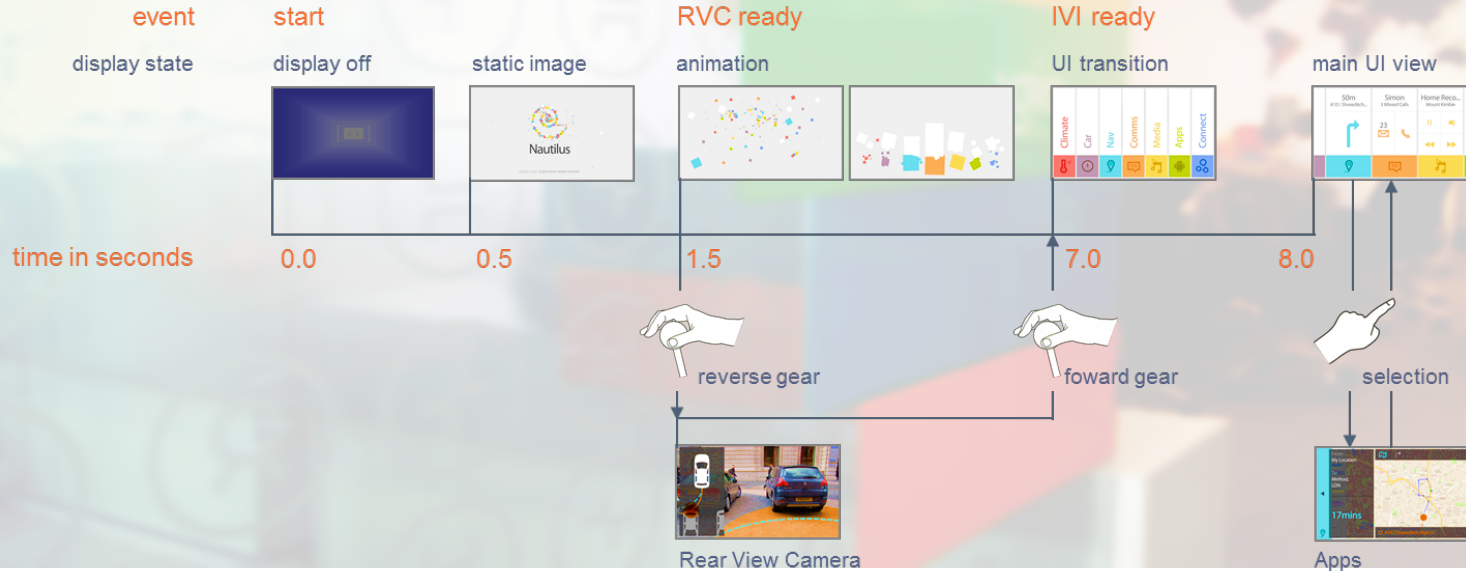
- For the peripherals that do not have full SMMU protection but have own MMU it still possible to implement memory access protection and translation with SPT-like approach. Generic implementation is provided to Xen by GL and ready for some coprocessors like GPU, IPU, BB2D, etc.



Nautilus on TI J6 – xen support upstreamed



Boot Time



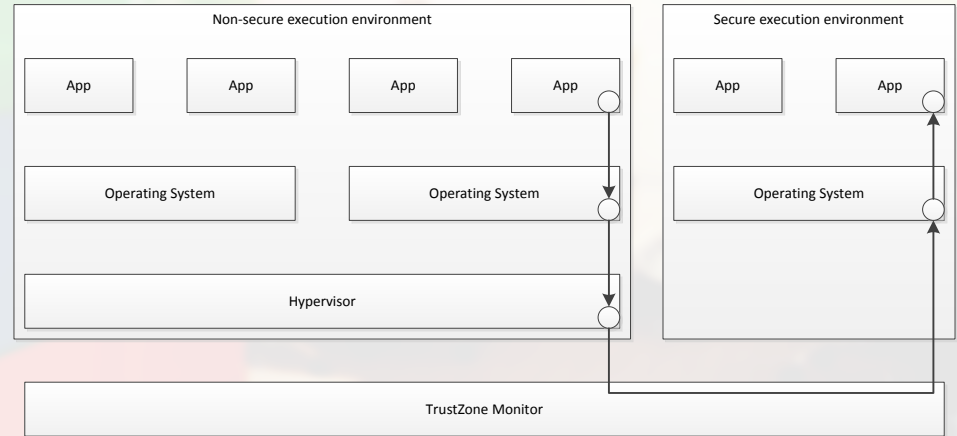
- u-boot loads Xen device tree configuration and Dom0 kernel
 - cold start to Xen start is less than 100ms
 - domain configuration, memory map, IRQ map passed to Xen through device tree

- Xen boot time on J6 is 300ms
 - all printouts are disabled
 - RAM wipeout is disabled
- Dom0 kernel boots in 800ms

Hypervisor vs. Monitor

Virtualization and TrustZone

- TrustZone is also kind of virtualization
 - Coexists with VMM but of higher privilege
 - Separated into 2 worlds only – Secure and non-Secure
- Typical tasks for TrustZone SW:
 - System boot protection
 - Application signature validation
 - Firmware integrity check
 - External peripherals whitelist
 - Secured peripherals drivers
 - Closed crypto algorithms implementation (DRM)
- Hypervisor integration notes
 - Boots before non-secure SW, i.e. before Xen
 - Xen shall allow domains to perform SMC calls
 - System control partitioning can be simplified with monitor mode (Power Management, etc.)



Power Management

- cpufreq: policy?
- cpuidle: policy?
- Multi-domain governance?
- ACPI? Not really.
- Thermal Management?



Future & Features

Xen SubProject – Embedded & Automotive PV Drivers – GL maintainers

- “Micro-kernel” approach – DOM0
- PV Drivers packages SoC’s specific reference
 - TI J6, Renesas R-Car M2, Freescale i.MX 8, A15/A50 SoCs
- ISO 26262 certification
- Guest OSs
 - Android, QNX, ArcCore (AUTOSAR), Tizen (GENIVI)

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