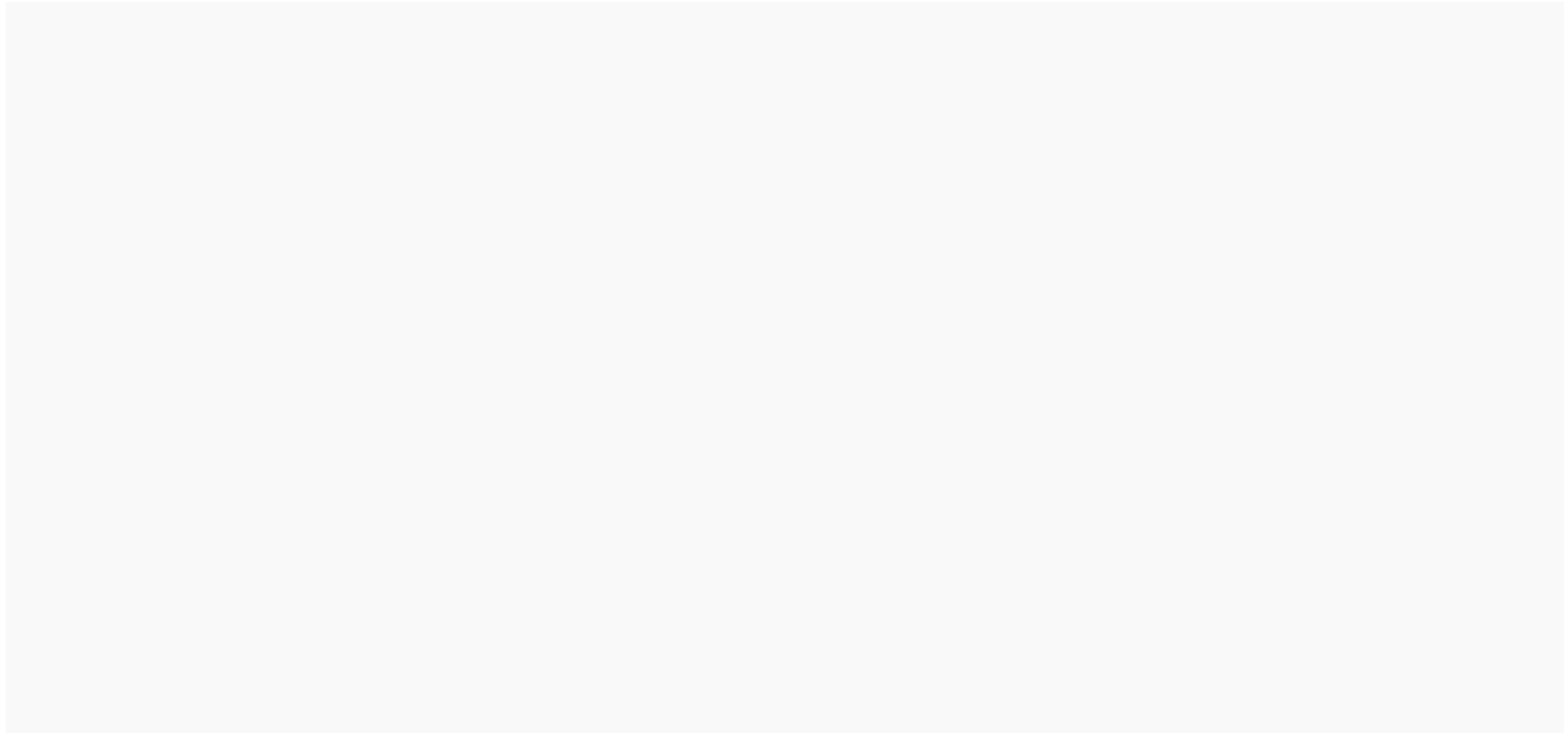




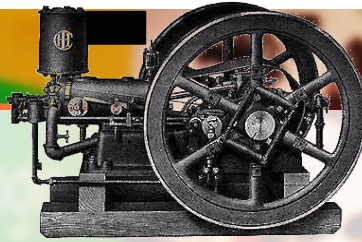
Xen Automotive

Next Big Thing is coming ...



Vehicles are Changing

- Car still bring us from point A to point B, but looks different inside
- Ford Sync software today contains 10,000,000+ lines of code
- Evolving industry
 - Short time to market
 - “Cloud” car
 - 3rd party applications
 - Cost reduction

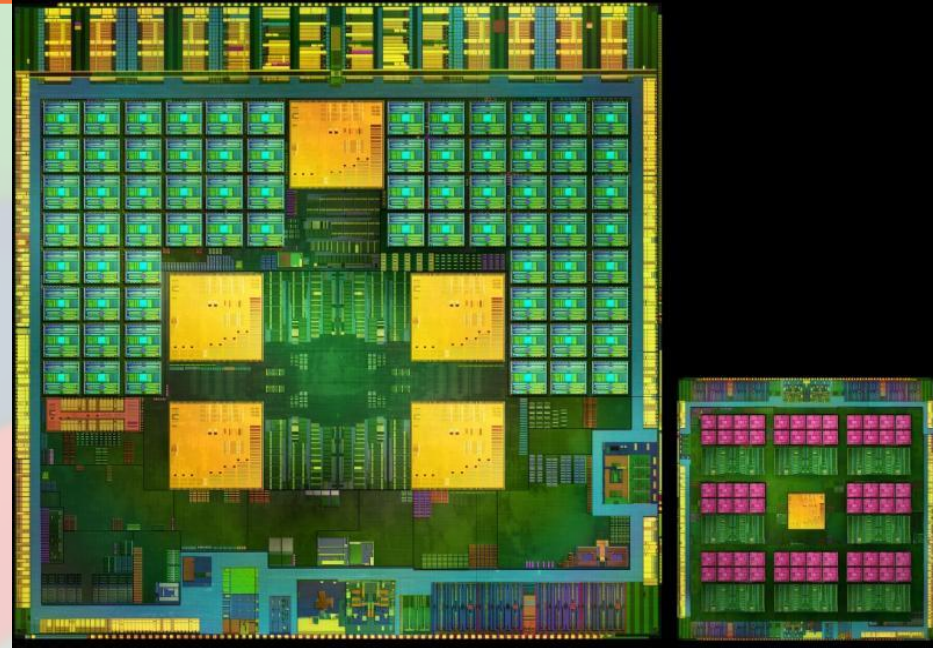


SYNC
Powered by **Microsoft**



Next Steps

- Combine different function on single computer
- Modern SoCs are powerful to perform different functions
 - Cluster Display
 - Central Console Display
 - GPU
 - HW MM accelerators
 - Security – ARM Trust Zone



Requirements

**Look and Feel
customization**

**Connected
Car Services**

**3rd Party
Applications**

**Quick
development
cycle**



Open Source for Automotive – Gaps

Stability & Reliability



Boot Time



Security



Why Xen?

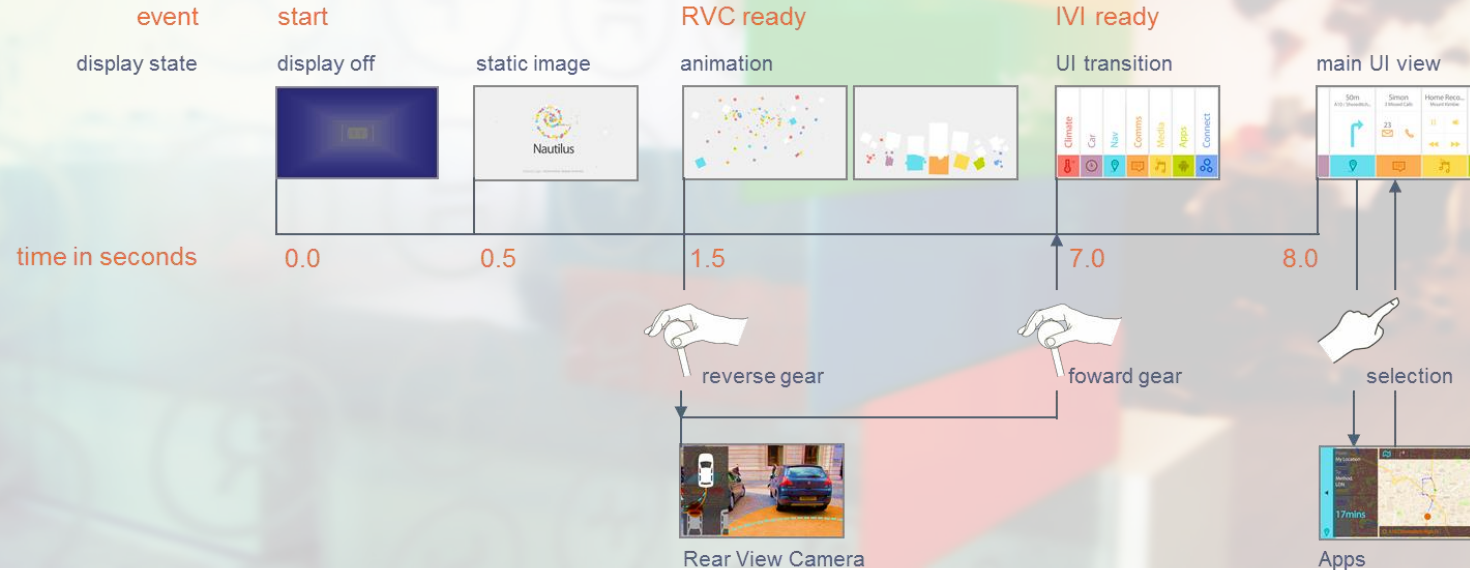
- Type 1 Hypervisor
- Flexible Virtualization Mode
- Driver disaggregation
- ARM support
- Open Source
- ~ 9k lines of code
- Mature since 2003 in general computing



Xen in Embedded

- With ARM support Xen is perfectly fit for embedded applications
- Experimental PV ARM support on Nvidia made by Samsung
- Full ARM HVM support starting 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
 - Better DT support
- TODO:
 - RT scheduler
 - More PV drivers
 - Debug, fix, stabilize...

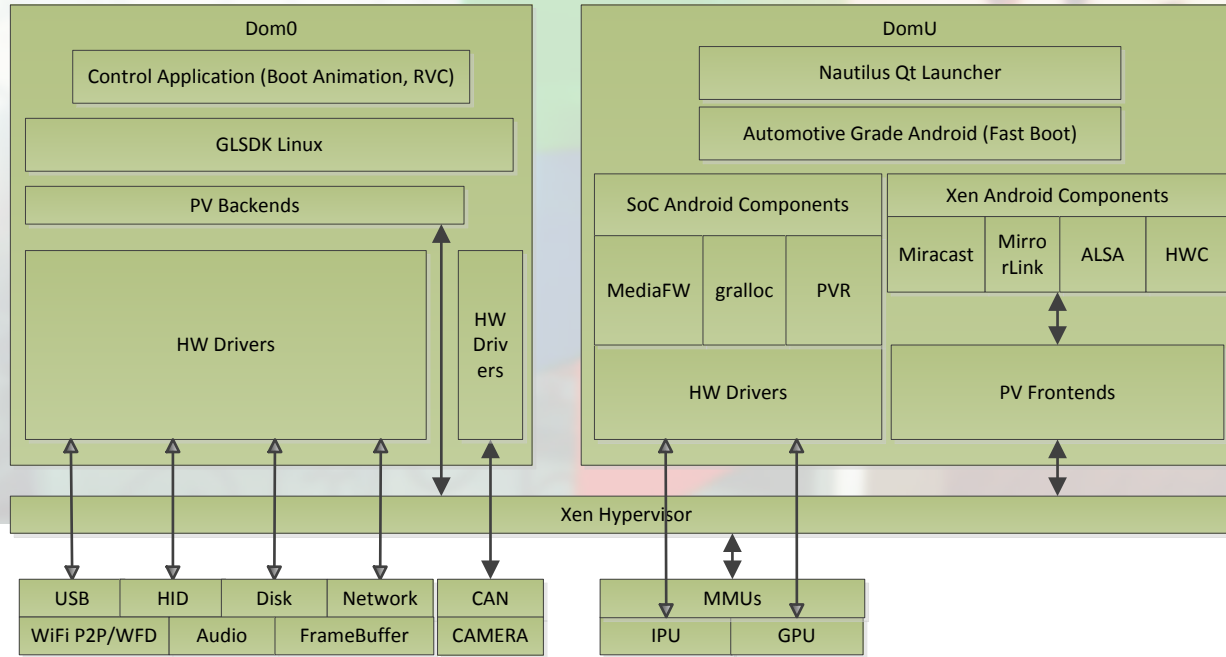
Boot Time



- 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

Nautilus on TI J6 – Sample Layout



PV Drivers

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

- 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 tinyALSA
- Framebuffer
 - NEW: kernelspace frontend and userspace backend, deliver 30 FPS on J6, WIP on 60 FPS
- TO DO:
 - GPS
 - GPU

GL MMU SPT Approach

Xen Paravirtualization (PV)

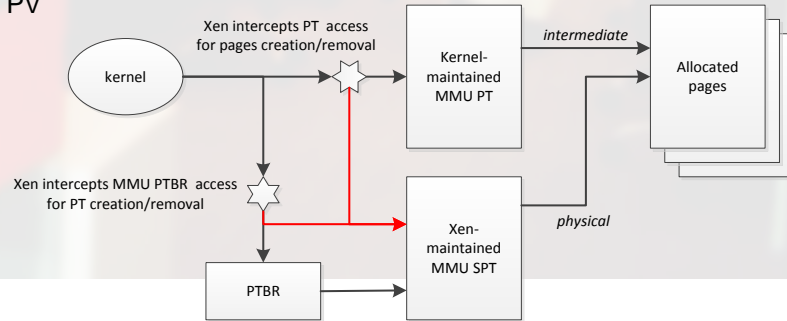
- Paravirtualization is an efficient and lightweight virtualization technique introduced by Xen, later adopted also by other virtualization solutions. Paravirtualization doesn't require virtualization extensions from the host CPU. However paravirtualized guests require special kernel that is ported to run natively on Xen, so the guests are aware of the hypervisor and can run efficiently without emulation or virtual emulated hardware.

Xen Full virtualization (HVM)

- Fully virtualized aka HVM (Hardware Virtual Machine) guests require CPU virtualization extensions from the host CPU. CPU virtualization extensions are used to boost performance of the emulation. Fully virtualized guests don't require special kernel, so for example Windows operating systems can be used as Xen HVM guest. Xen can emulate HW or provide access using PV drivers to improve performance

GL MMU SPT Approach

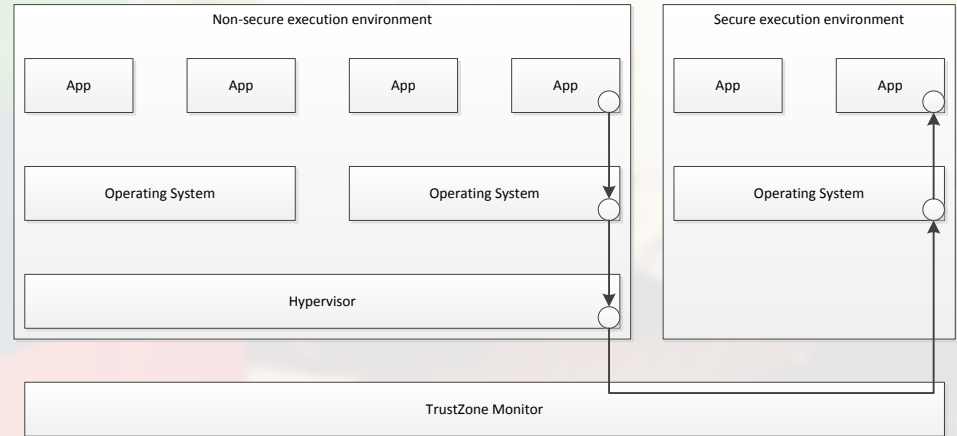
- For the peripherals that do not have full SMMU protection but have own MMU it still possible to implement memory access protection and translation with SPT-like approach. Generic implementation is provided to Xen by GL and ready for some coprocessors like GPU, IPU, BB2D, etc.



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.)



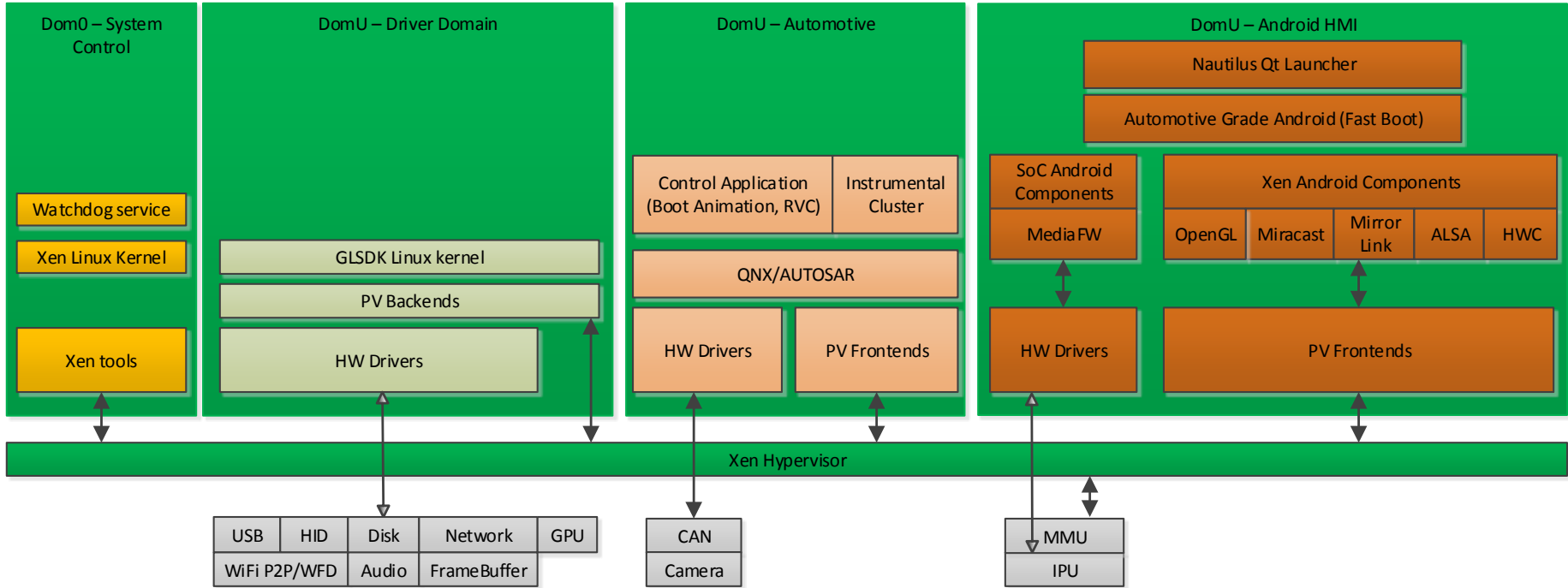
Future & Features

Xen branch for Automotive

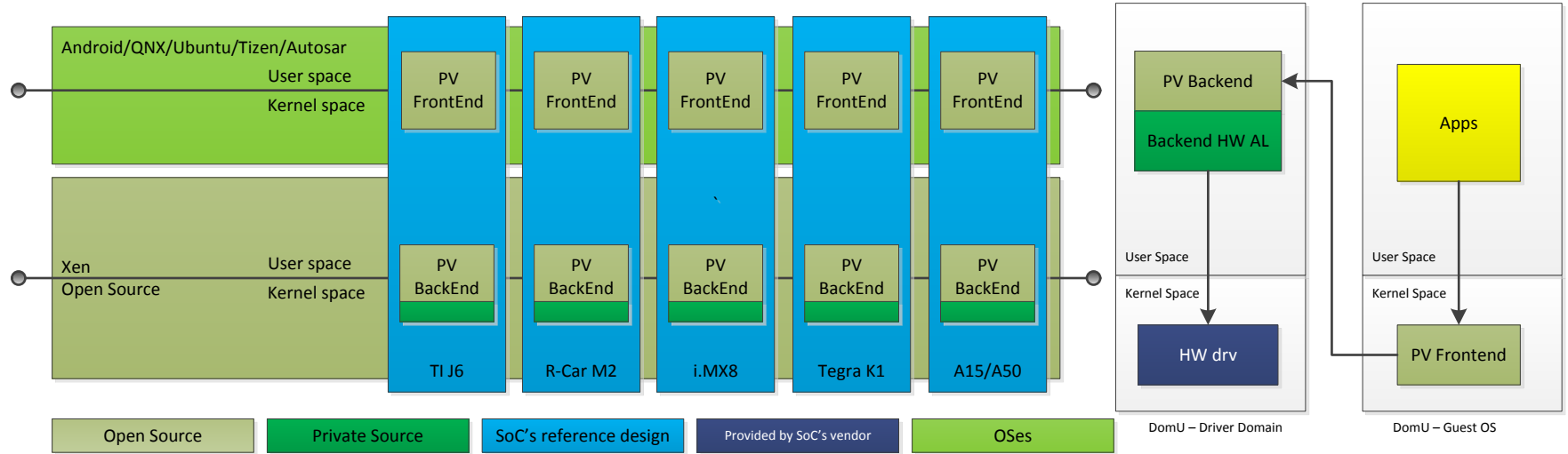
- “Micro-kernel” approach – DOM0
- PV Drivers packages SoC’s specific reference
 - TI J6, Renesas R-Car M2, Freescale i.MX 8, A15/A50 SoCs
- Guest OSs
 - Android, QNX, Autosar, Ubuntu, Genivi Linux, Tizen, Yocto



Automotive VMs Layout



OSS/Private



- Xen Automotive – open source license
- SoC's vendors PV Drivers – private source license
- IVI's OEMs SW/HW adaptation – private source license

About GlobalLogic

- Technology services company
- Headquartered in Silicon Valley
- Design studios in the US and UK
- Engineering centers in the US, Ukraine, India, Argentina, China
- 1,000+ product releases
- 250+ active clients
- 7,000+ people



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Q&A



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Thank you

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