Facing the Reality: What's new in the L4Re Operating System

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• Spin-off from TU Dresden
• Founded by core developers
• www.kernkonzept.com
L4Re Microkernel System

L4Linux

VM

Library OS

Application

VMM

Driver

Service

... ...

Memory Mgr

IO Mgr

Roottask

... ...

L4Re Runtime Environment

User

L4Re Microkernel (Fiasco.OC)

Kernel
L4Re Key Features

- Set of building blocks
- Lots of contrib packages!
- Highly modular
- Broad platform support
- Virtualization
- User/Kernel co-design
- Dynamic + static setups
What's new in L4Re
L4Re Microkernel Updates
ARM Support

- ARM hardware assisted virtualization support
- Allwinner SoC (sunxi) support
- Omap5 support
X86 Support

- Suspend/Resume (S3)
- Can be booted on UEFI platforms
- SMEP
Tools Support

- clang/LLVM support work in progress
- gcc 5 is work in progress
- Tools support is "continuous integration" effort
L4Re Runtime Environment Updates
Suspend/Resume

- User space side implemented by io
  - Inhibitor locks
- ACPI events
- Works with L4Linux
IO Manager

- Transition to lua as configuration language
- Refinement of the GPIO multiplexing API
- GPIO pin as device resource
- GPIO drivers for BCM2835 & OMAP3-5
- Configured via device tree
Stack Protector

- Terminator canary
- Prints error message if compromised
Virtio - Work in Progress

- Library with virtio primitives
- Queues
- Rings
- MMIO interface
- Allows implementation of virtio host side
L4Re Virtualization Update
L4Linux

- version 3.18, continuous update
- virtio-l4 backend
- Filesystem server
- Framebuffer server
L4Android

- updated to 4.4.4
- Lollipop is work in progress
- Technology demo available
L4Android Screenshot
L4KVM

• Feature-rich VMM (read: runs Windows)

• Use KVM from within L4Linux

• X86 support
  • SVM and VT-x
  • 32/64bit

• Nested paging
L4KVM Architecture
ARM Hardware Assisted Virtualization

Non-secure World

User

Secure World

Trusted Services

Kernel

PL0

PL1

Trusted OS

Monitor
ARM Hardware Assisted Virtualization

Non-secure World

- **PL0**: User, User
- **PL1**: Kernel, Kernel
- **PL2**: Hypervisor

Secure World

- **PL0**: Trusted Services
- **PL1**: Trusted OS
- **PL3**: Monitor
ARM Hardware Assisted Virtualization

Non-secure World

- PL0: User
- PL1: Kernel, VMM

Secure World

- PL0: L4Re App
- PL1: Trusted Services
- PL2: Trusted OS
- PL3: Monitor

L4Re Microkernel
Problem: Booting

- Secure Software installed
  - OS typically boots in Non-secure PL1
  - How to get to PL2?
- No Secure Software
  - Boots in secure mode
  - Hyp mode only in Non-secure world
Solution: Booting

- Support on secure side required

- Secure side switches to PL2
Solution: Booting

- Support on secure side required

- Launch in Non-secure PL2 mode
ARM Hardware Assisted Virtualization

- Supported by L4Re Microkernel
  - Tested with Exynos5 and OMAP5
  - Platform boot is the key!
- VMM in package vmm
REALITY-CHECK
L4Re Microkernel

• EFI ✓

• Tools ✓

  • Minimal required gcc version 4.5
  • clang still work in progress
  • continuous effort (e.g. compiler blacklist)
L4Re Userland

• Power management ✓
Virtualization

- ARM ✓
- L4KVM ✓
- L4Linux 64bit - still experimental
- L4Android ✓
Outlook
L4Re Microkernel - Interesting Topics

- ARM64
- IOMMU
- Both require user space support
- Towards more static configurations
L4Re Userland

- RPC framework
- Native AHCI driver
- Lua 5.3
  - Real integers and bit operators
- Application debugging
- Extend tool support: clang and GCC 5
L4Linux

- Use device tree support on ARM
  - Shall help device enablement
Resources

- www.kernkonzept.com
- l4re.org
- Talk with us
THANK YOU