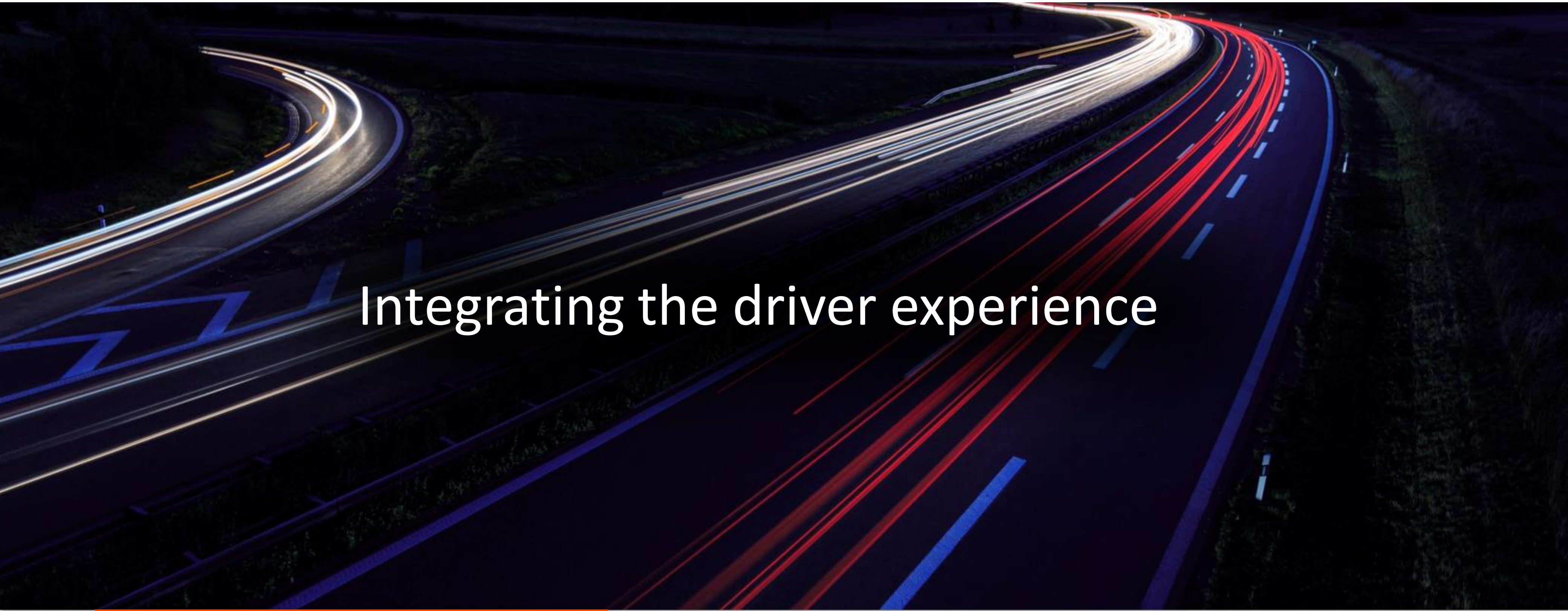
OPENSYNERGY



Hypervisor Return of experience Session

Genivi AMM Munich 2019

public

How **Not** to ~~Share~~ Virtualize Devices

1. Do Not Replace User Space Libraries

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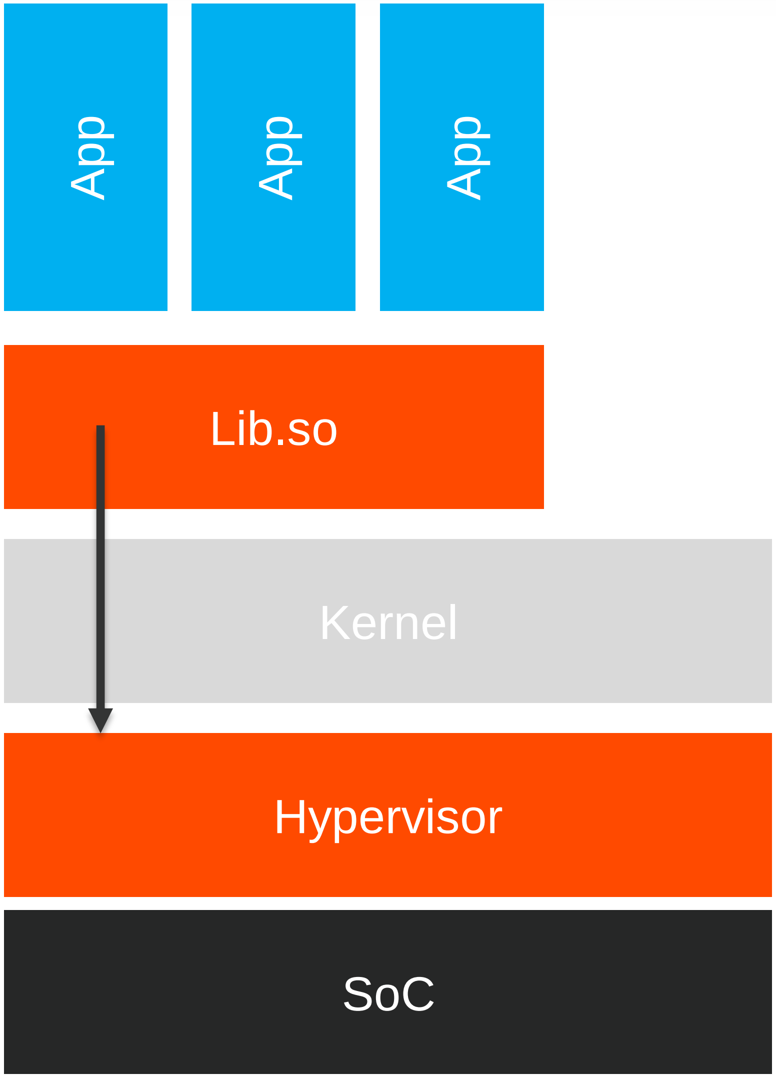
- Don’t Replace an existing user space library with a hypervisor specific one
- Typical attempts
  - libdrm.so
  - libteec.so (trustzone access)
- The kernel is bypassed, therefore
  - User space resources need to be managed in hypervisor
  - App lifecycle management leaks into hypervisor

Better: Implement drivers using driver frameworks provided by operating system



2. Do Not Replicate Kernel Subsystem APIs

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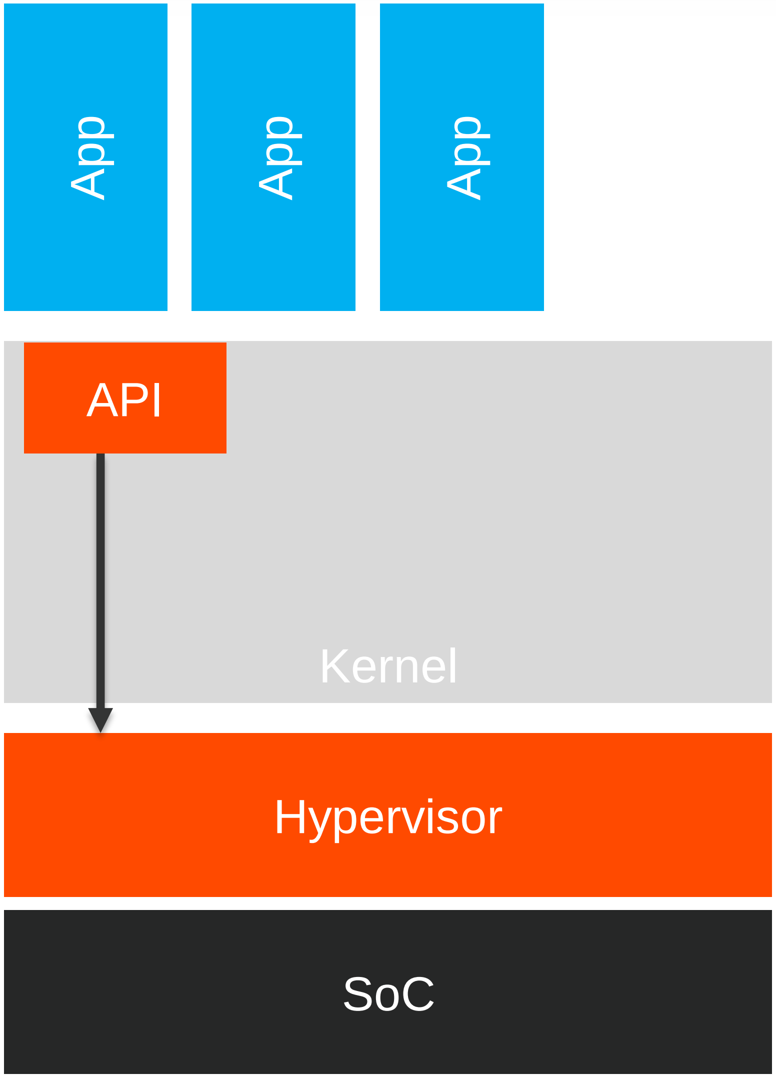
- Don’t Re-implement an operating system API
  - Same operating system handle reference as original device
  - IOCTLs
  - Read/Write Functions
- Typical approach
  - Drm/kms
  - Fbdev
  - GPIOfs
- Complete implementations of “shim” layer end up being really bad re-implementations of existing subsystems

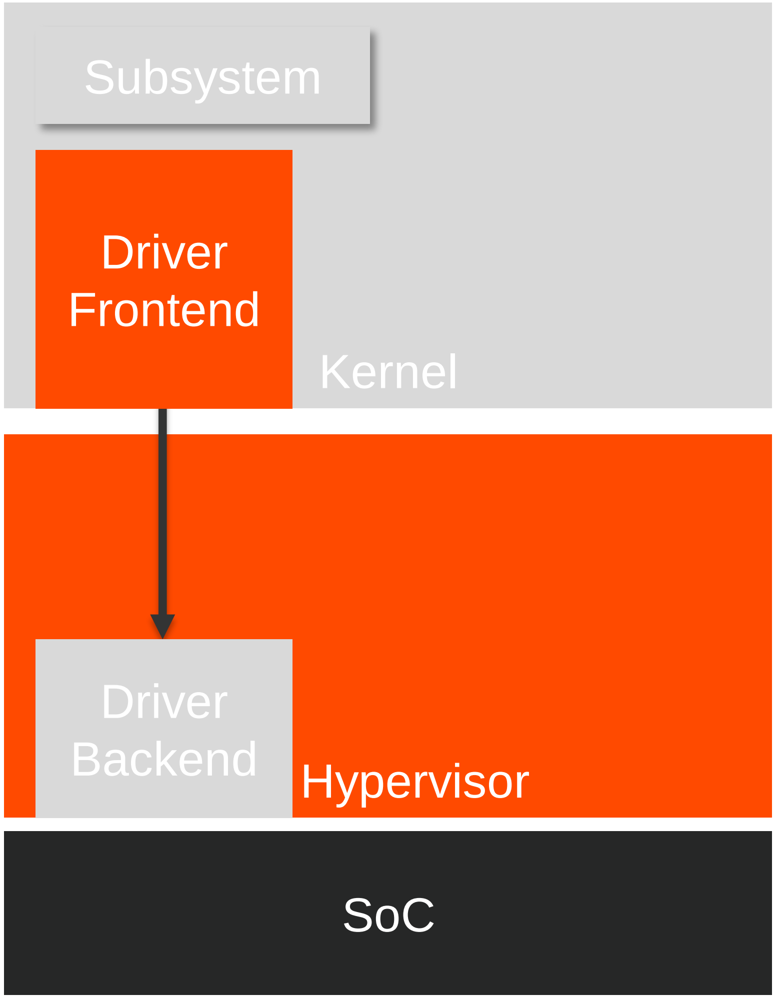
Better: Implement drivers using driver frameworks provided by operating system



3. Do Not Split a device driver

- Don’t Take **existing** device driver and cut it in half
  - Leave upper half in guest kernel
  - Move lower half into hypervisor
- Can be very efficient
  - Possibly low overhead
  - Looks very simple
  - Many drivers have mid-layers where a cut is easy
- Typical approach
  - GPU drivers
- Most mid-layers are very leaky
- Modification of existing driver cuts off update paths
- Very hardware specific
- The devil in the details, usually takes multiple times longer than planned

Better: Find good functional abstractions and implemented SoC agnostic drivers



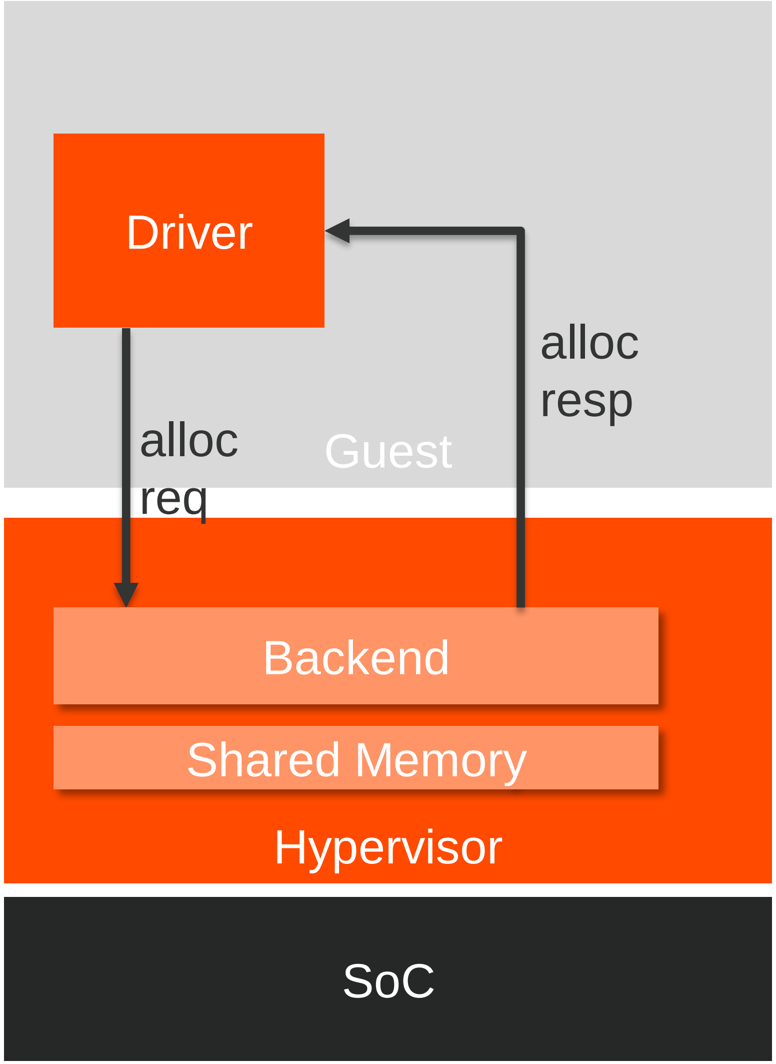
4. Avoid Host side allocations

Problem

- Guest needs to allocate “special” memory
  - Cache coherent
  - Device accessible (<4gig)

Naïve solution

- Remote memory allocation



- Bookkeeping is distributed
- Memory owner might have different lifecycle than Memory manager
- To avoid memory starvation
  - Pooled allocations -> memory waste

Better: Import guest buffers, teach guest to manage buffers himself, use iommus

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Virtualize device functions – not devices!

Virtualized device Architecture with VIRTIO

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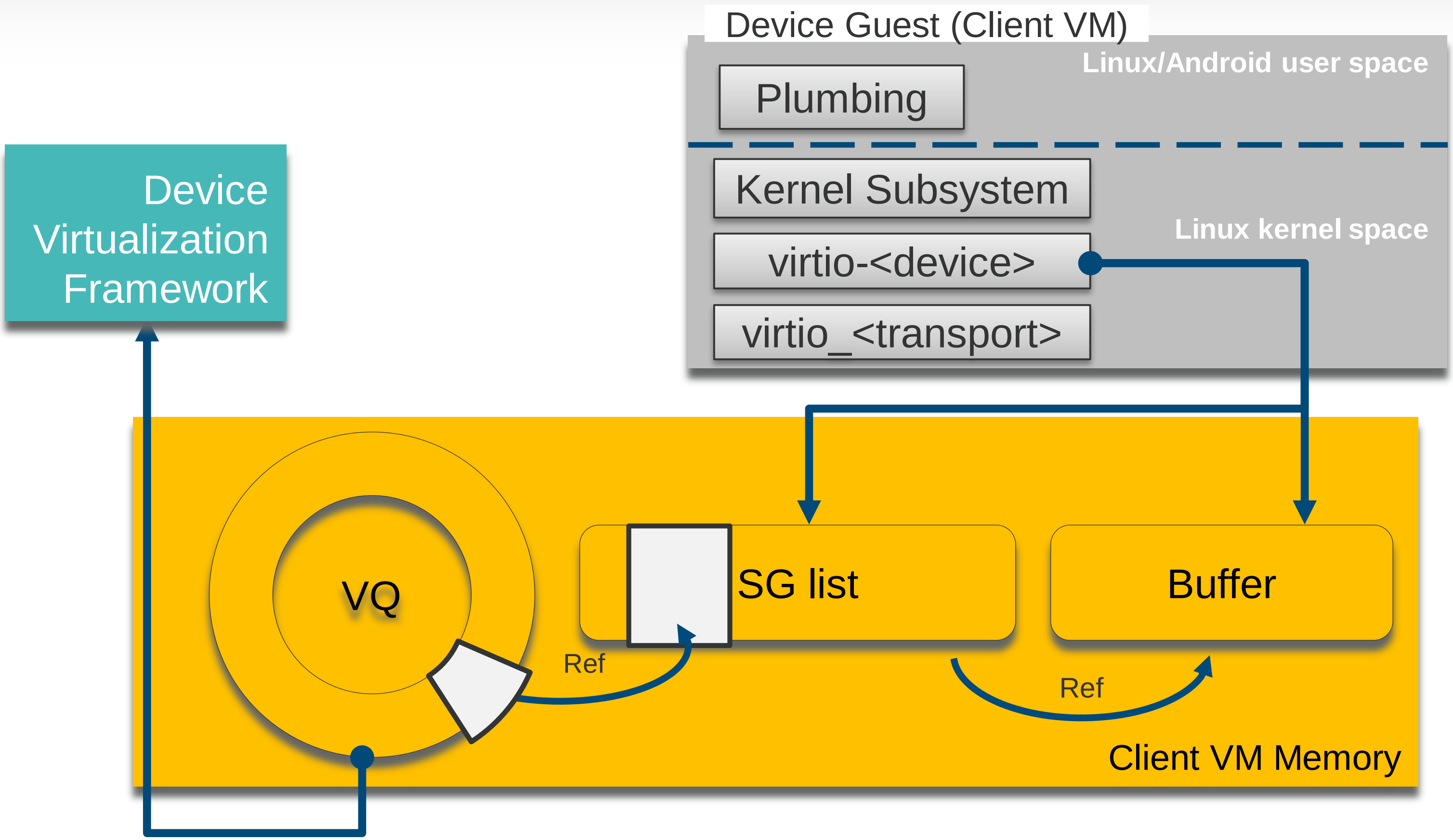

- Drivers in Kernel
- Uses existing subsystems
- Only abstract device functions
- All allocations in guest memory

Bulk data transport via DMA-like memory model

- Buffer **allocations** handled by „Driver“ part (client)
- **Direct** R/W access to allocated buffers in the „Device“ part (server)

Metadata transport via virt-queues (ring buffers, asynchronous pipeline)

VQ=virt-queue
SG=Scatter Gather

System Management Architecture

Classical Design (Example)

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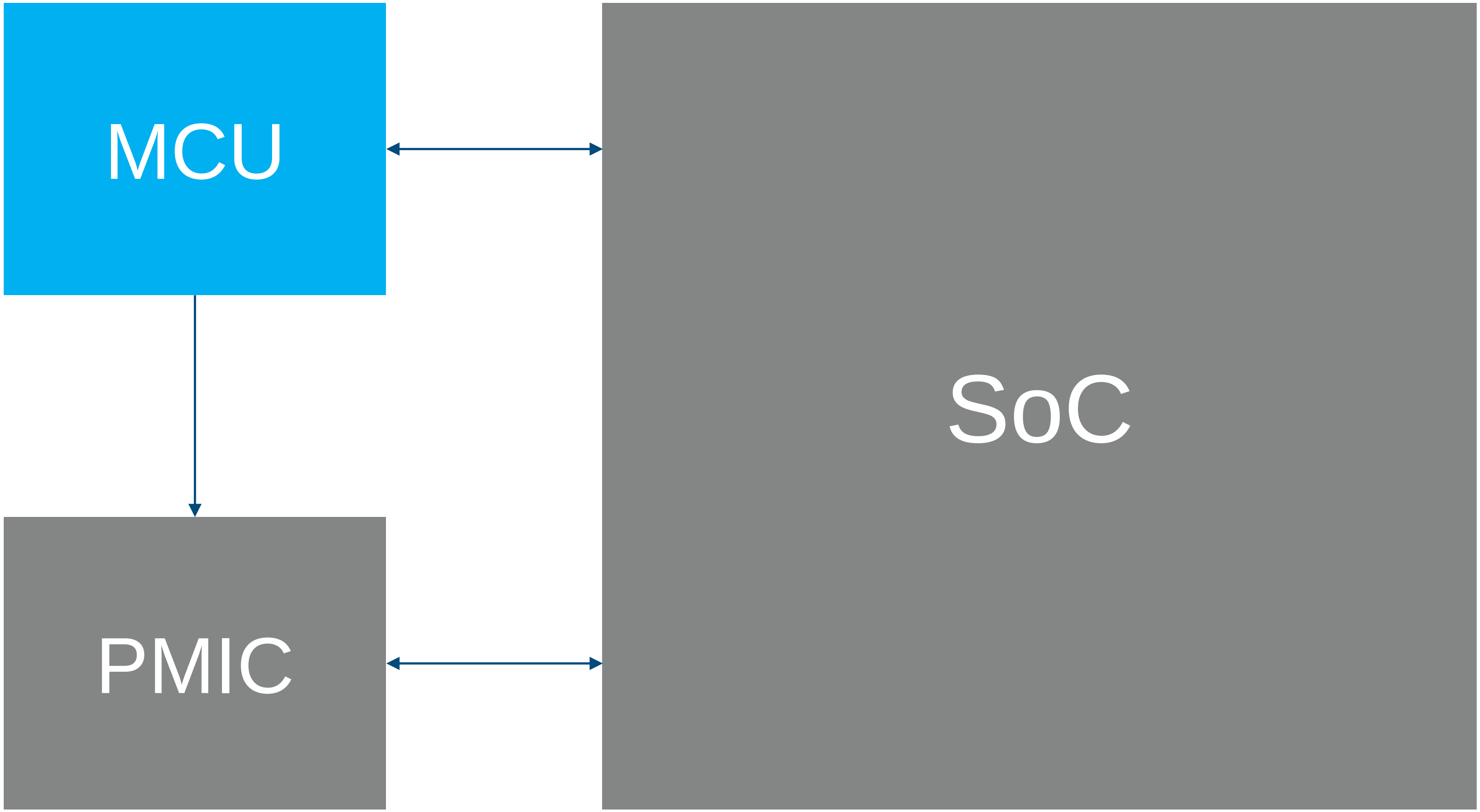
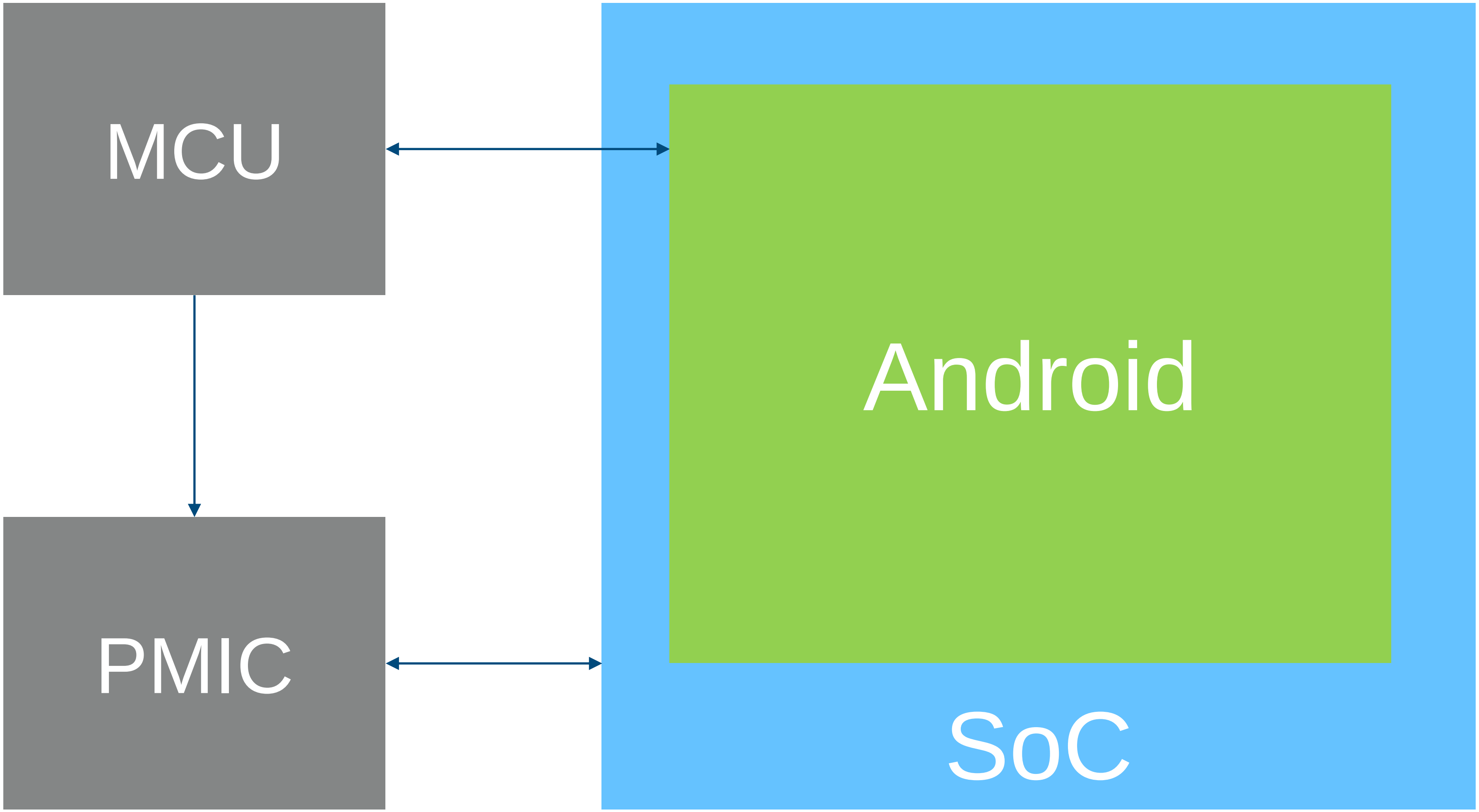


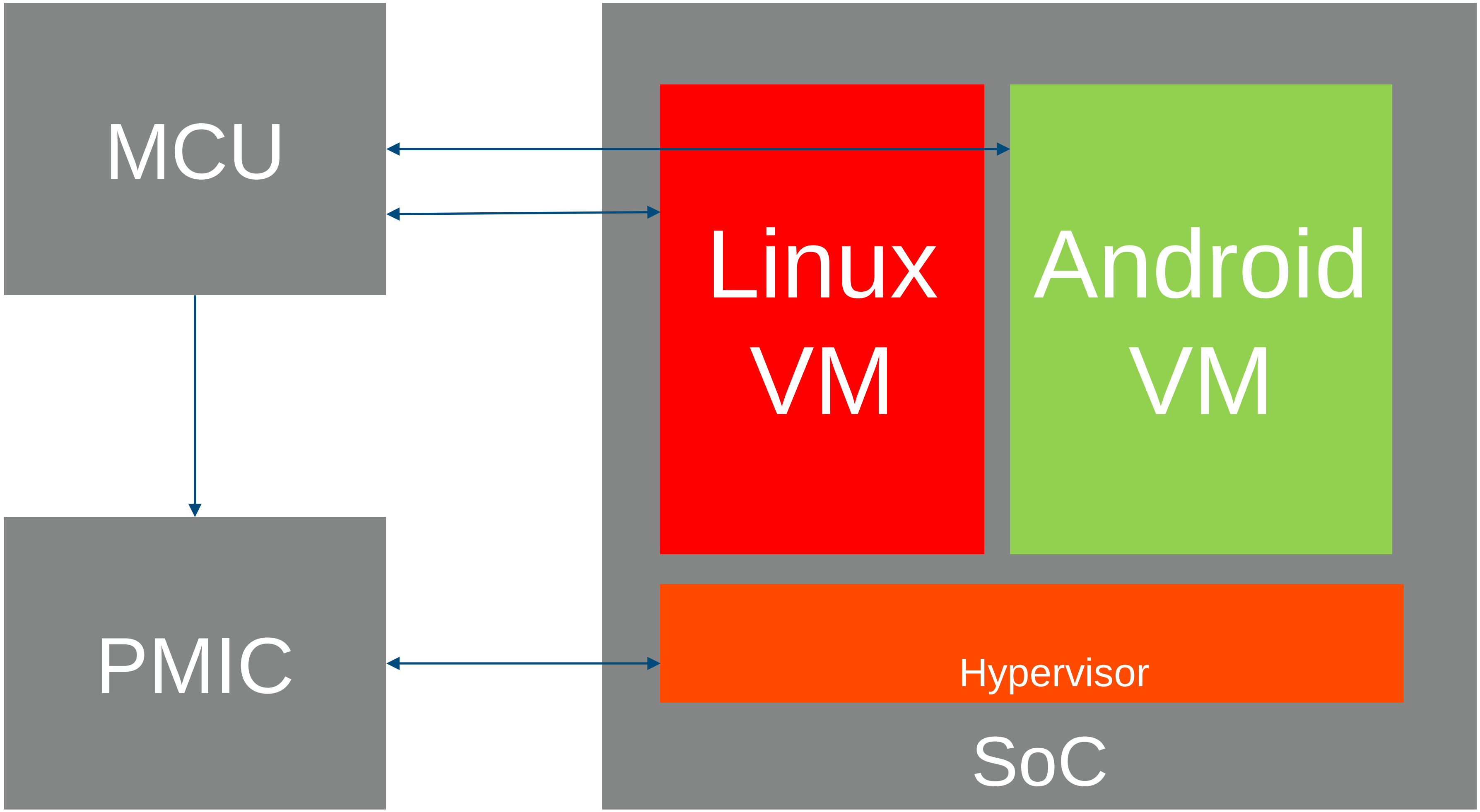
The MCU controls the systems state, using its own state machine

Android Design Assumption (example)



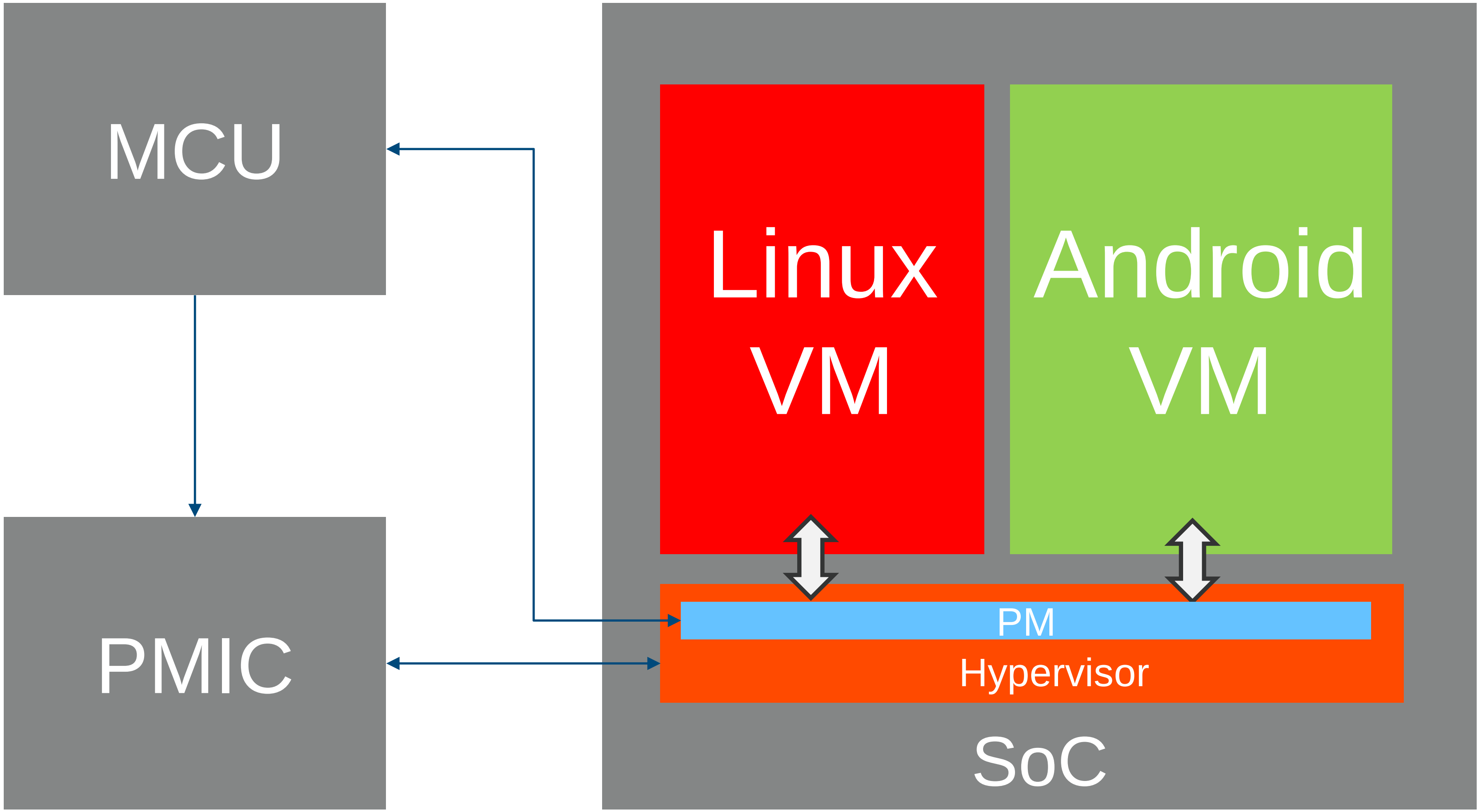
The MCU is demoted, Android is the new master of the state

Example system (Android+Linux)

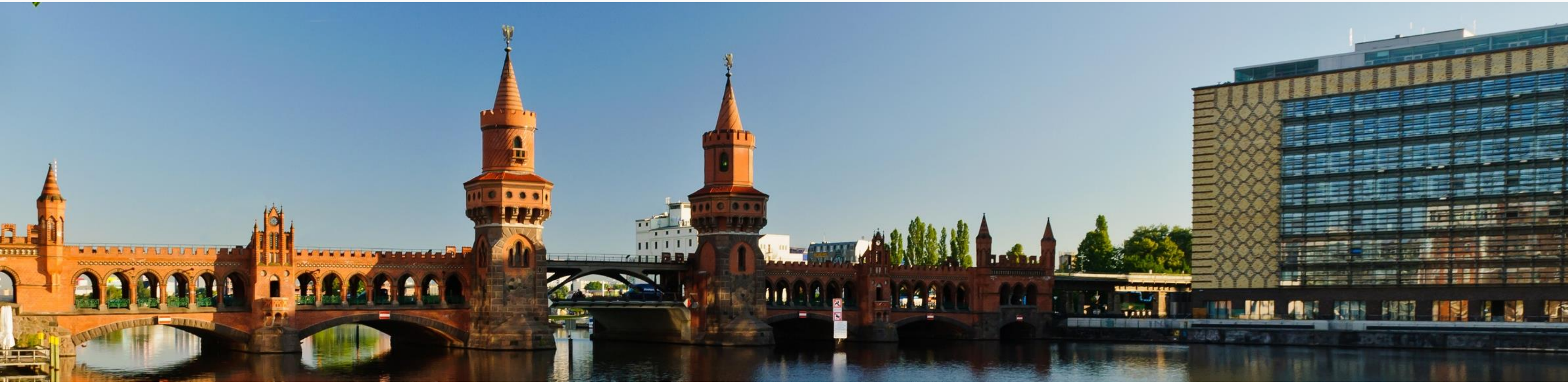


Who is the new master?

Example system (Android+Linux)



Central decision point in hypervisor, but guests “believe” they are in charge



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