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Jailhouse: An Open-Source Hypervisor for connected (and many other) things

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Overview

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Why using a hypervisor?

- Consolidation
- Isolation
- Mixed-Critical applications

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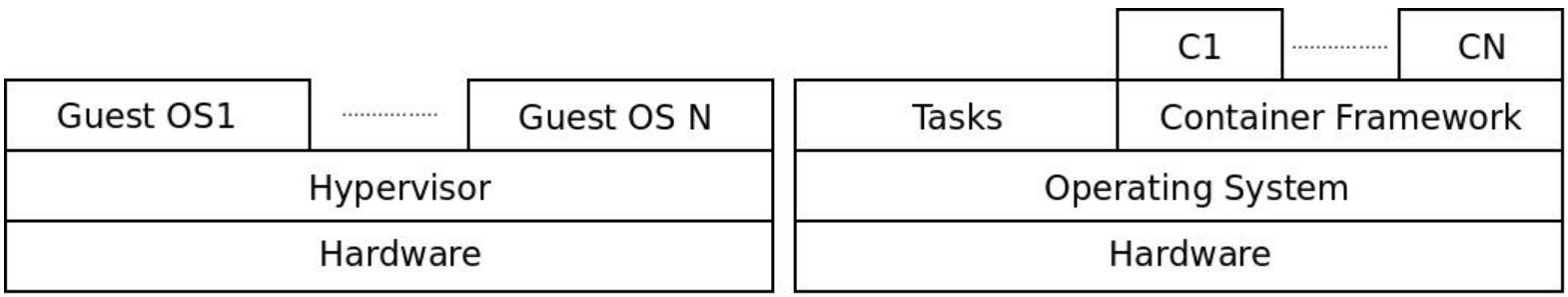
What do we need?

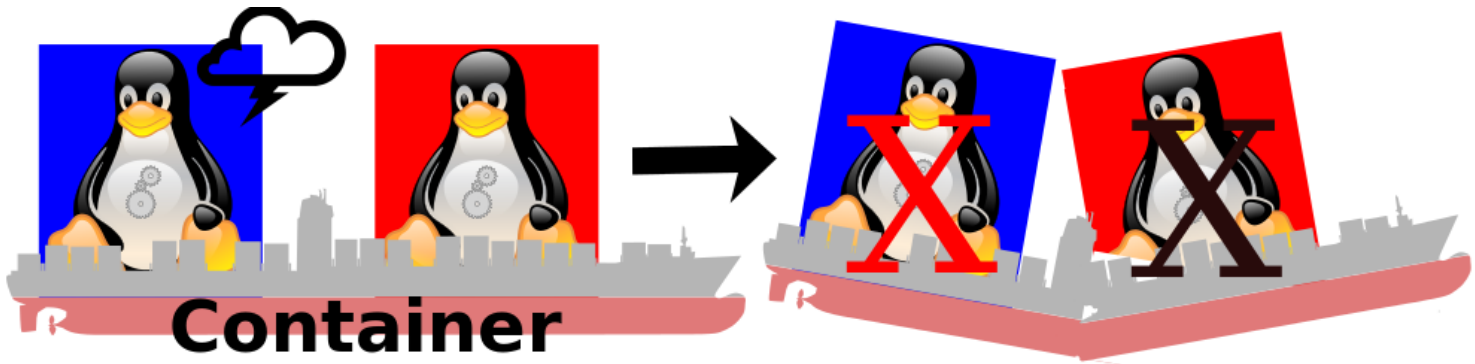
- A hypervisor that scales pretty well
- A small code base (verification and certification)
- Best possible isolation

So, why not containers?

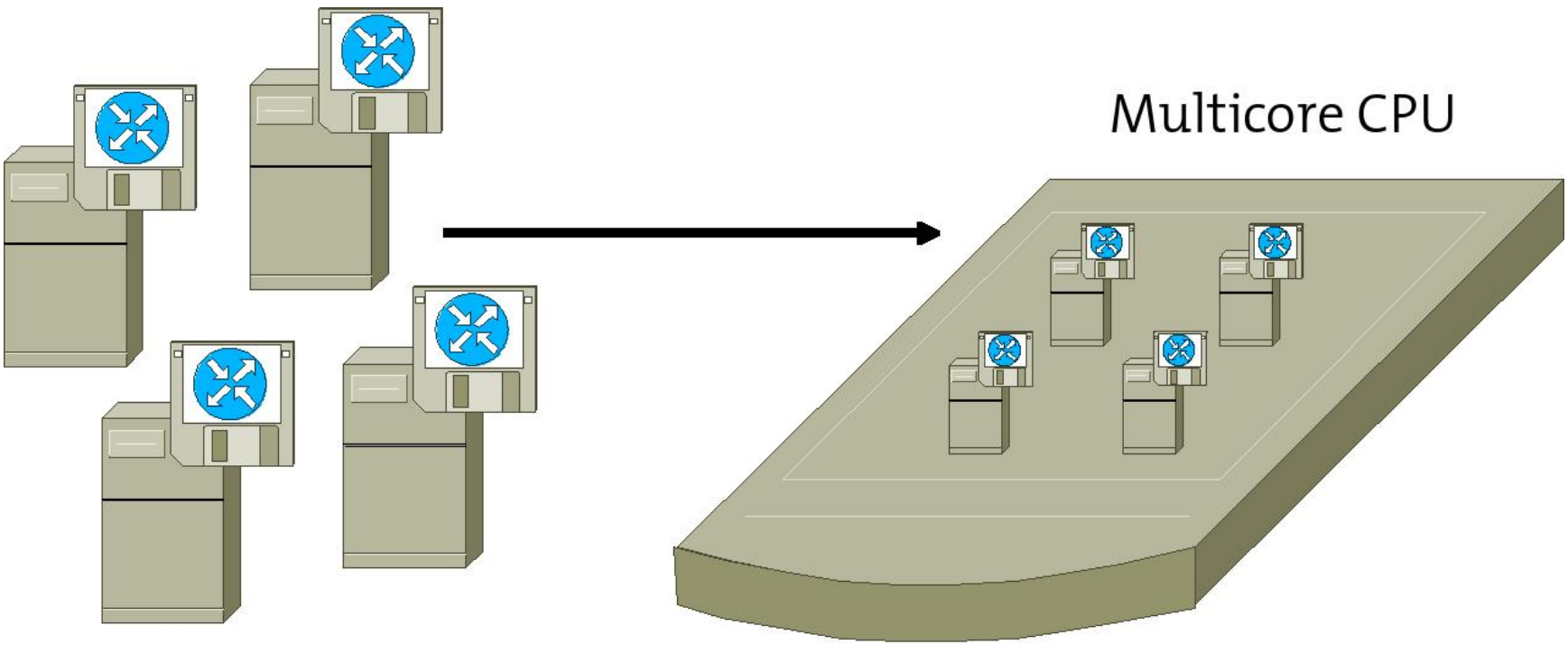
- Think about isolation!
- Different operating systems



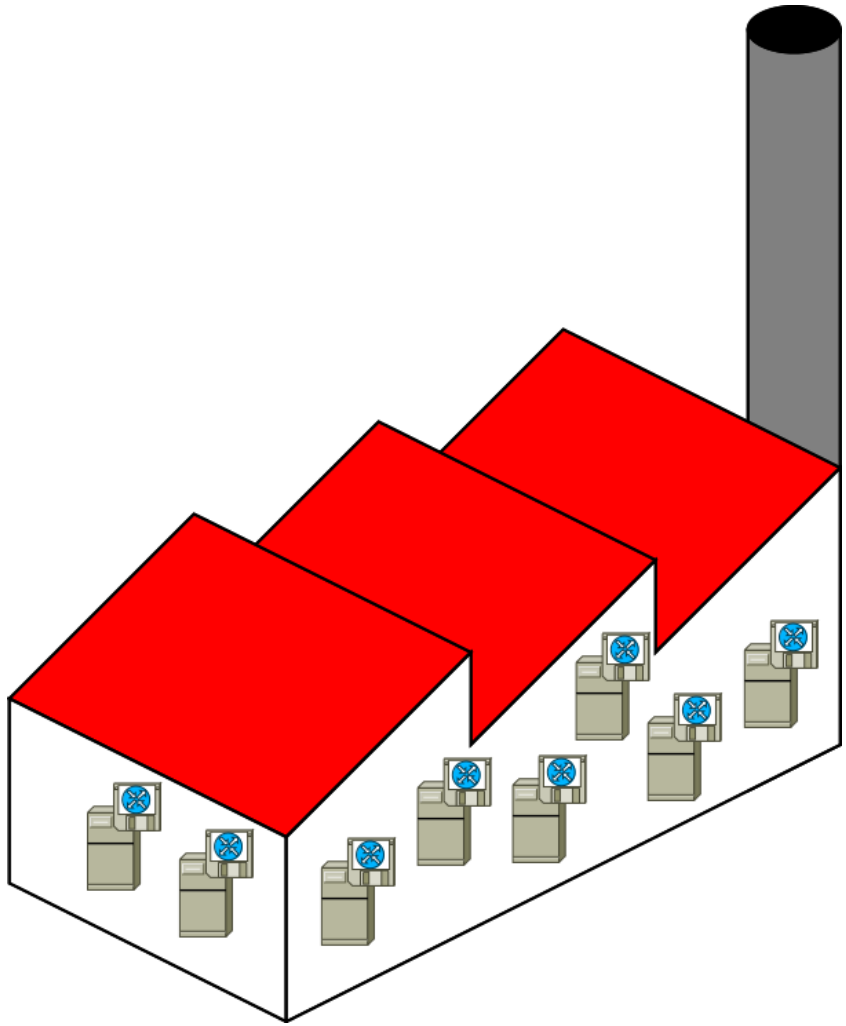
Impact of an Operating System fault when using containers



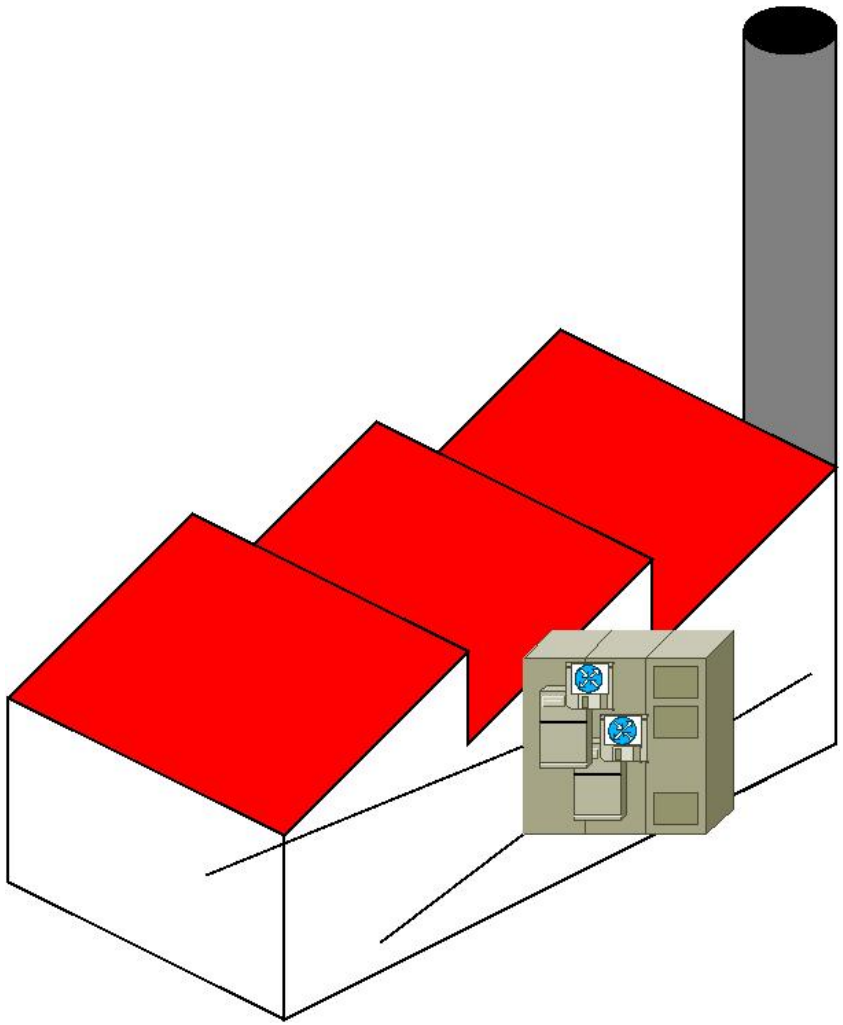
Example: Use multicore CPUs efficiently



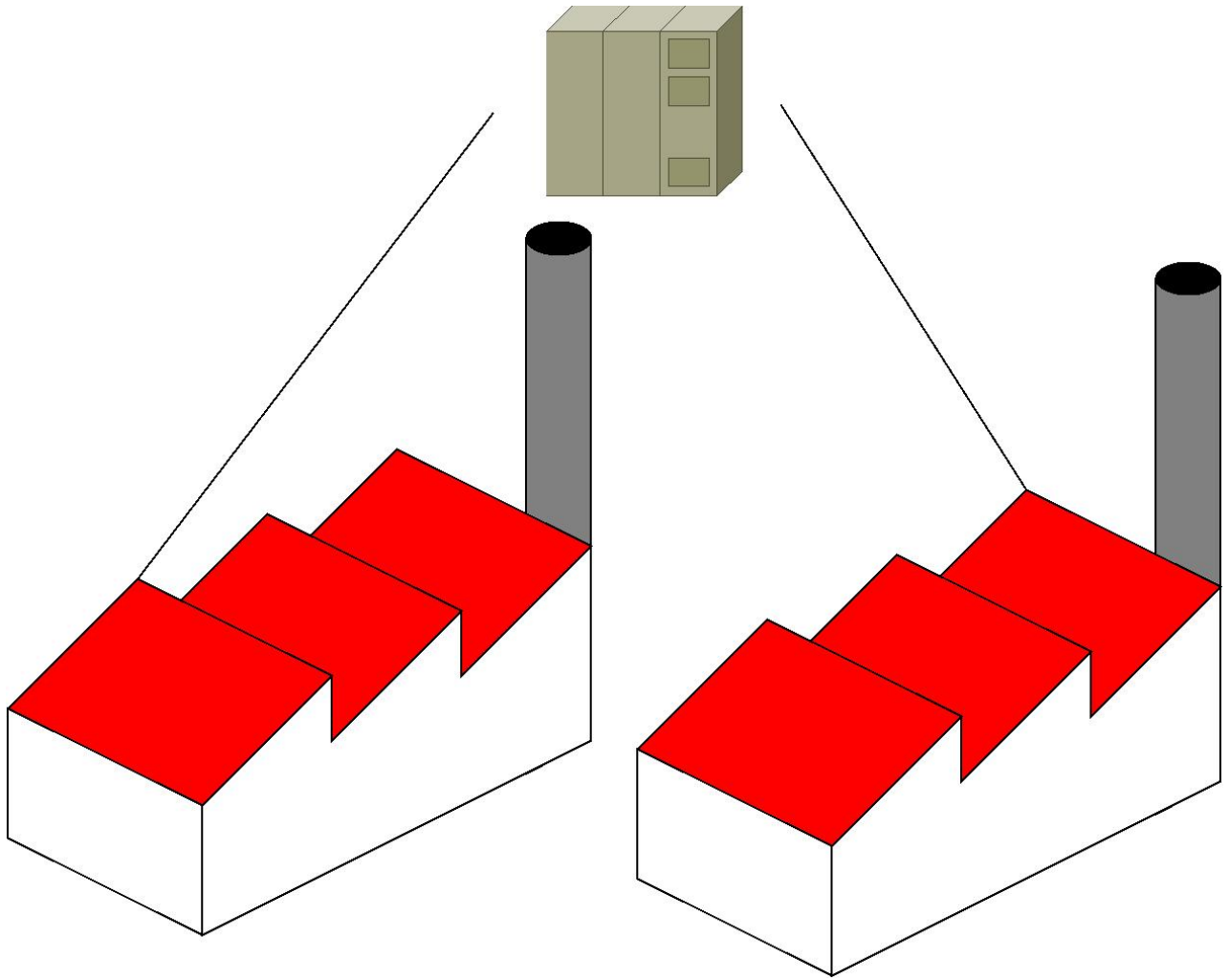
Example: Consolidation



Example: Consolidation ctd.



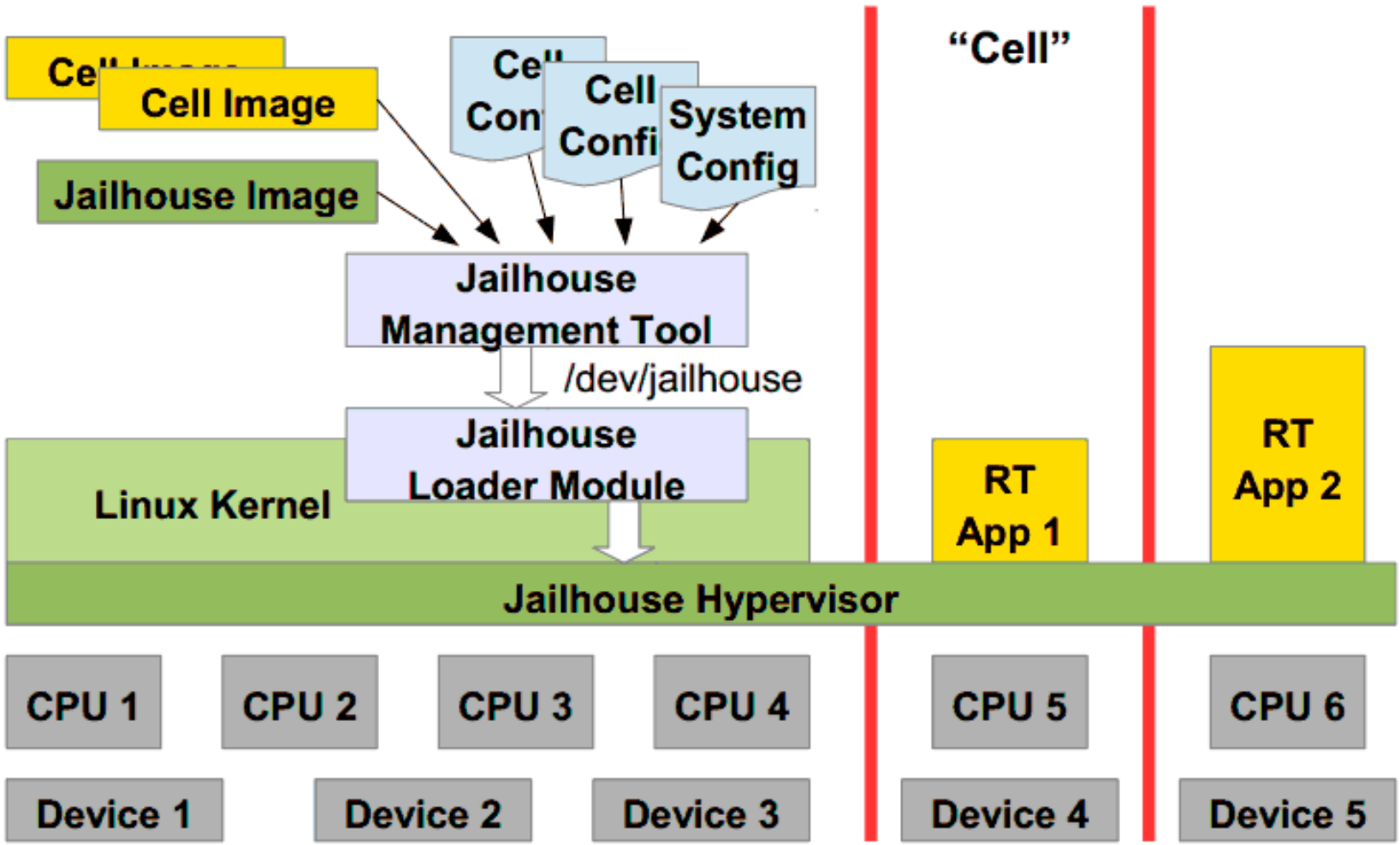
Example: Consolidation ctd.



What is Jailhouse?

- Hypervisor with static partitioning
- Open-Source (GPLv2)
- Developed and maintained by Siemens
- Management Interface based on Linux
- Isolates so called "cells"
- These cells can run bare-metal applications or any OS
- Currently x86 and ARM are supported

What is Jailhouse? (Source: Siemens)



Jailhouse Hypervisor

Static Partitioning (NO emulation)

- Ressources must be assigned to a cell
- Optimal isolation of each cell
- Full HW control
- The so called "root cell' is re-used as a management interface. This leads to:
- Small and simple code base (round about 8k LoC per architecture)

Cell configuration

```
        .cpus = {
                0xf,
        },
        .mem_regions = {
                /* RAM */ {
                        .phys_start = 0x0,
                        .virt_start = 0x0,
                        .size = 0x3b000000,
                 .flags = JAILHOUSE_MEM_READ | JAILHOUSE_MEM_WRITE |
                          JAILHOUSE_MEM_EXECUTE | JAILHOUSE_MEM_DMA,
[...]
        .pci_devices = {
                { /* VGA */
                        .type = JAILHOUSE_PCI_TYPE_DEVICE,
                        .domain = 0x0000,
                        .bdf = 0x0008,
                },
[...]
```

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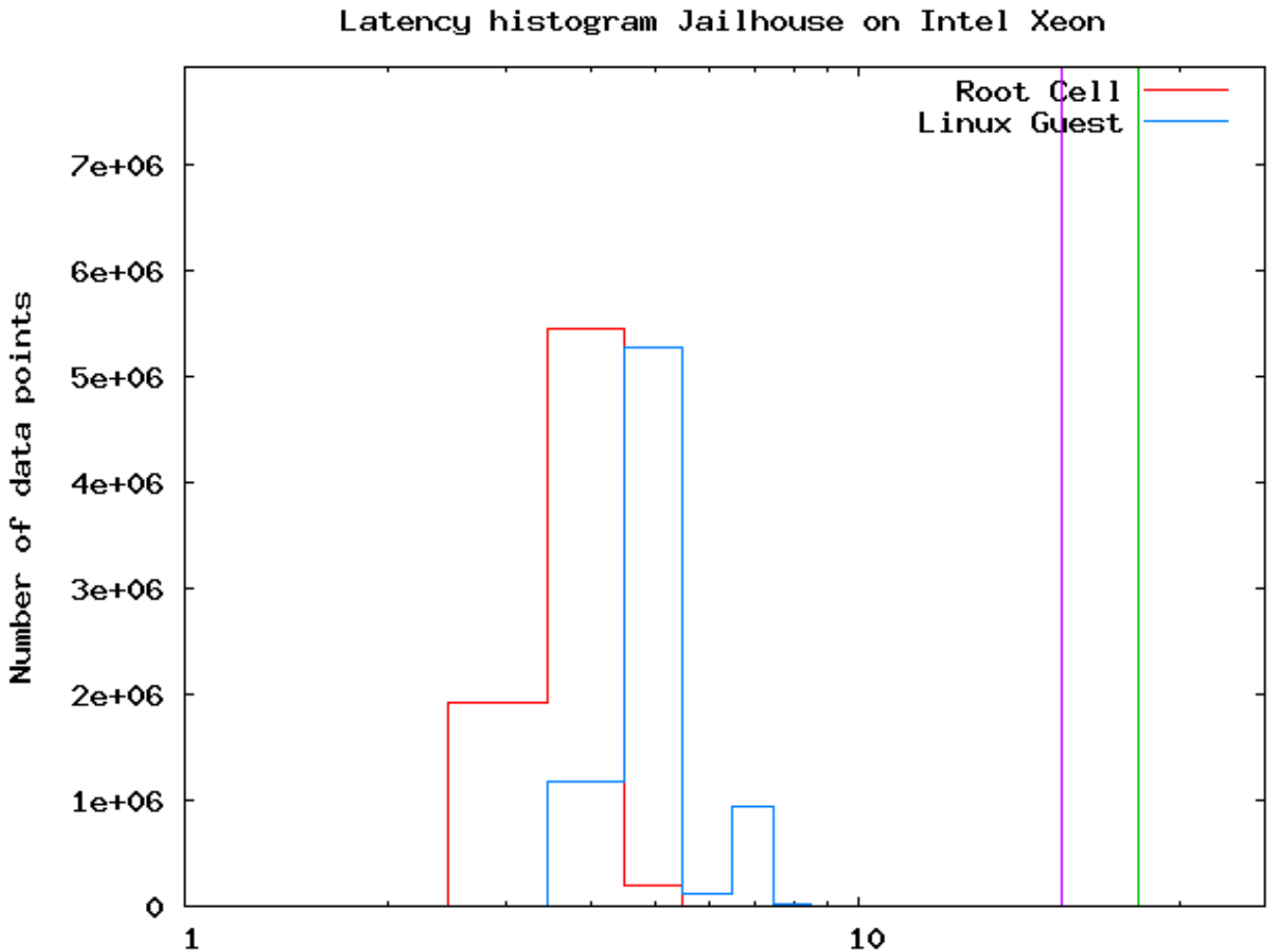
Jailhouse in the pICASSO project

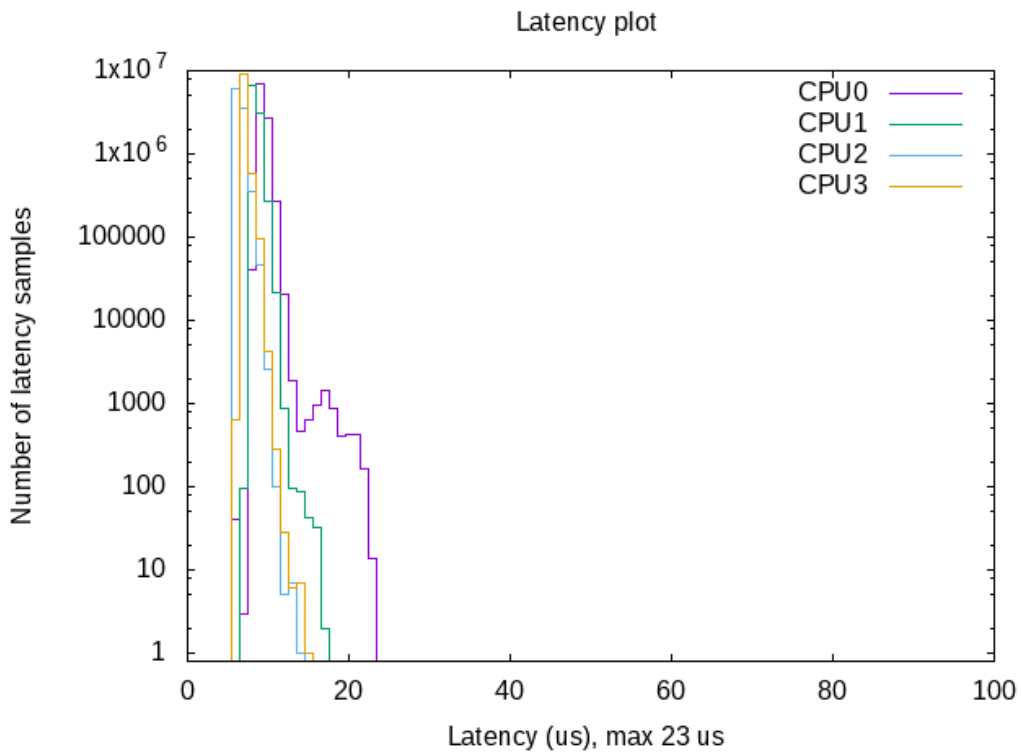
- Demonstrator at the ISW
- Connected to well known componentes from the "IT world" (libvirt)
- Participation in the Jailhouse project

Results: Timertask (Linux Guest with PREEMPT_RT)



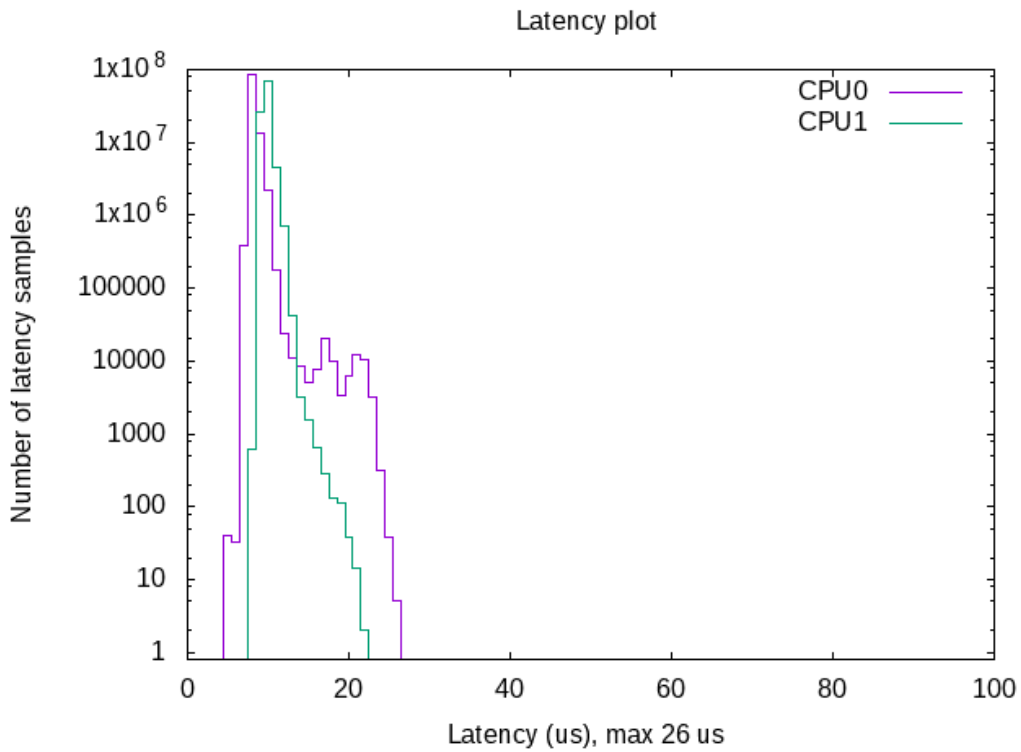
ARM: Timertask (Zynq Ultrascale)

Native Linux system:



ARM: Timertask (Zynq Ultrascale)

Within Jailhouse Guest (2 Cores used by the guest cell):



Attention!!

- Full partitioning is not always possible (e.g. shared caches amongst CPUs)
- Using a hypervisor for isolation DOES NOT replace a security concept
- Just remember "Meltdown" and "Spectre" (exploiting the host from a guest is possible)

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Conclusion

- Hypervisor technologies can be used for: Consolidation and separation
- Jailhouse is completely Open-Source
- Jailhouse scales from a simple ARM CPU (with VT extensions) up to big server machines
- "mixed critical" scenarios are possible (concept discussed with TÜV Rheinland)
- Be careful: The isolation of different components doesn't replace a security concept

Vielen Dank für Ihre
Aufmerksamkeit

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