A kernel in a library
Genode's custom kernel approach

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Outline

1. Motivation
2. Overview
3. Scheduling
4. Capabilities
5. Communication

Outline

Genode on third-party Kernels

The impetus of diversity

- NOVA, Fiasco.OC, OKL4, L4ka::Pistachio, L4/Fiasco, Linux SeL4

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Kernel perspective

- Aim for comprehensive security concept

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- Bring Kernel concept in line with Genode API

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- Bring Kernel concept in line with Genode API
- Must be trusted anyway

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Drawbacks

- Concepts get bend in shape (Signals)

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- Work is done redundantly (memory management)
- Deficiencies get worked around (Capability delegation)

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- Kernel that trusts Core and is designed for Core's needs
- Minimalistic library that enables Core to run as root domain
- Run most critical code in the simplest manner

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Kernel tasks

- Exception vectors

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- Virtualization

Kernel interface

	Threads, VMs	PDs, Capabilities	Communication, IRQs
Core-only	thread new/del thread start thread pause thread resume thread route event thread quota vm new/del vm run vm pause	obj new/del pd new/del pd update	signal receiver new/del signal context new/del irq new/del irq ack
Common	thread pause current thread resume local thread yield	update data region update instr region cap ack cap delete	signal context kill signal submit signal await signal ack msg send request msg send reply msg await request

Qualities

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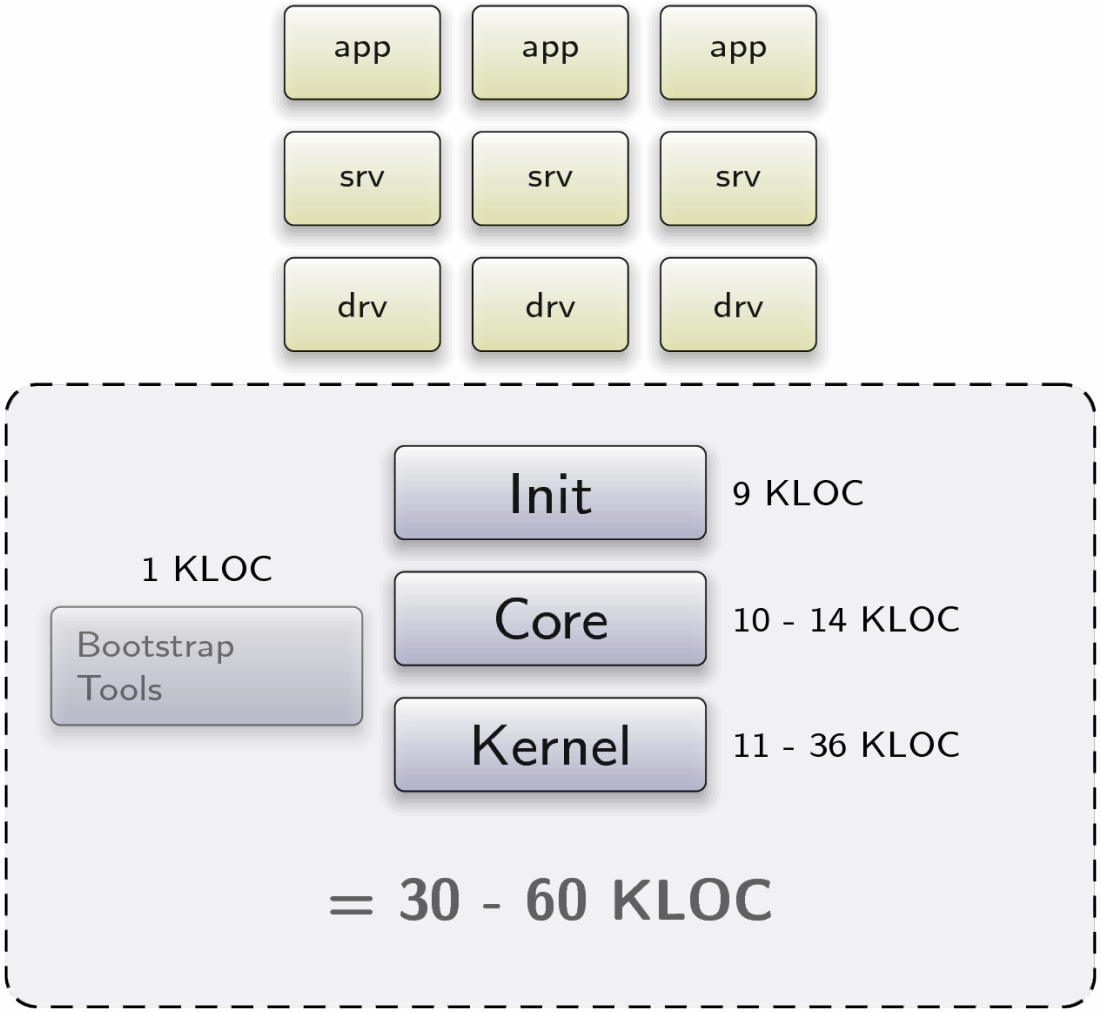
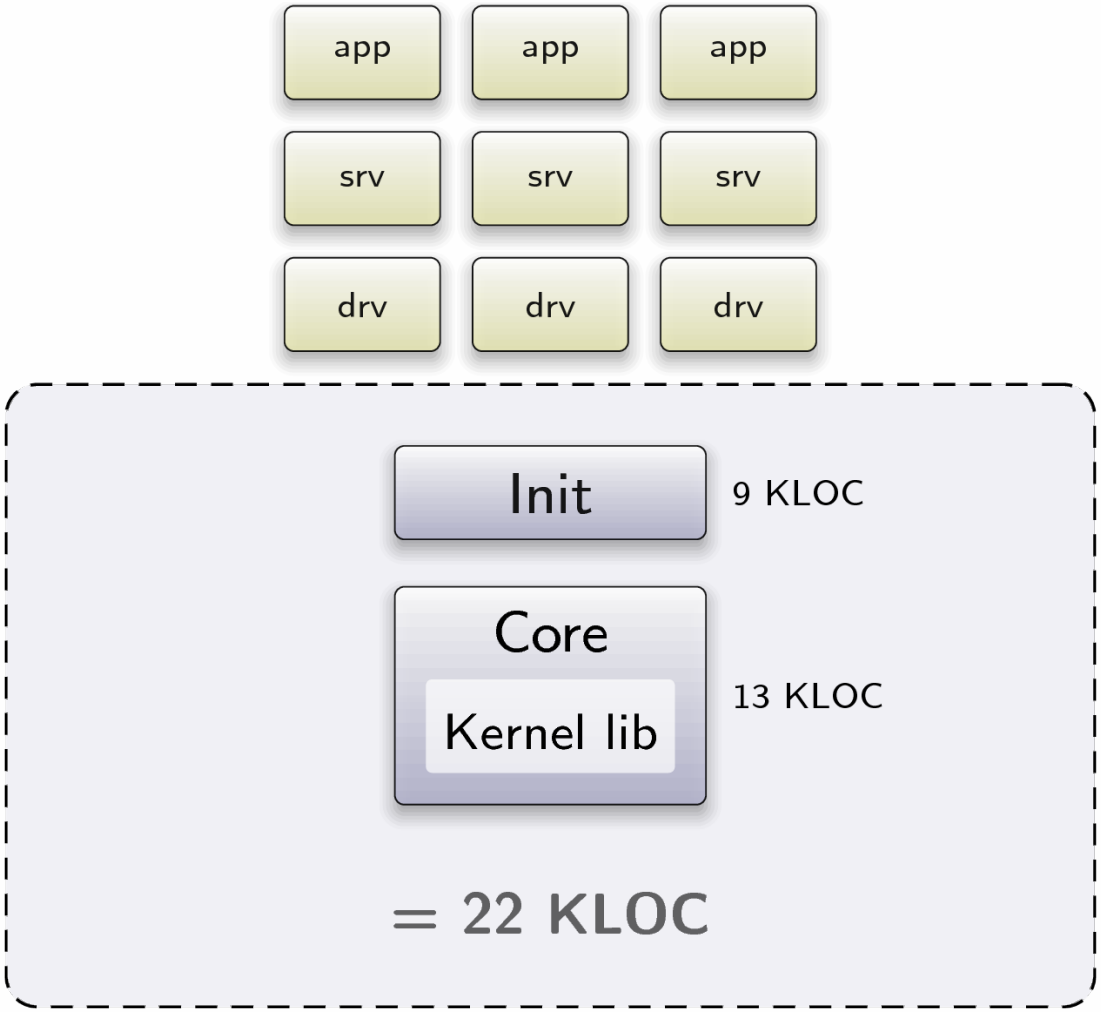
  $\rightarrow$ No exhaustion
- Modeled as state machine
  $\rightarrow$ Low complexity
  $\rightarrow$ Fast kernel passes

Trusted Computing Base



Trusted Computing Base



Hardware support

- ARMv7
  - Panda Board, i.MX53 QSB, USB Armory, Wand Board, Arndale, Odroid XU, Zynq, PBXA9
  - SMP, Virtualization, Trustzone, ...

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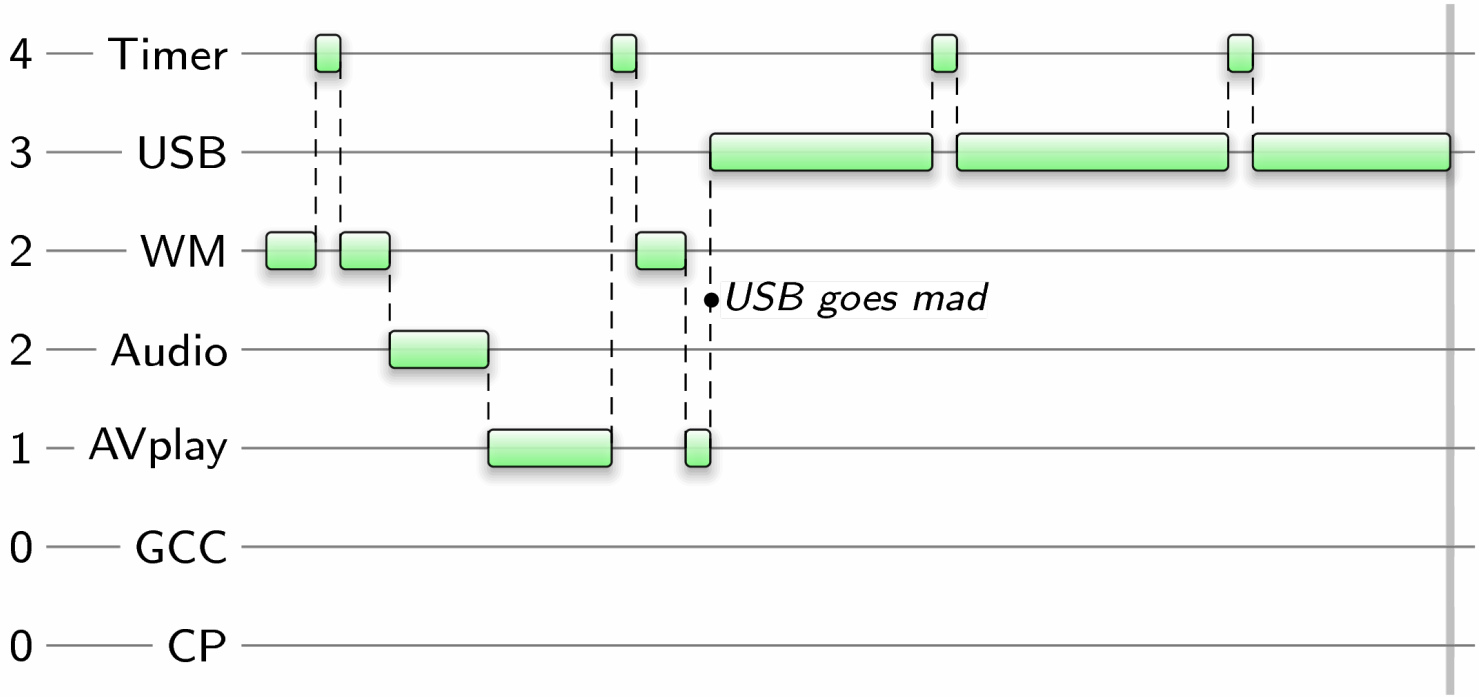
- x86 64 Bit, Raspberry Pi (ARMv6), RISC-V, Muen Separation Kernel

Outline

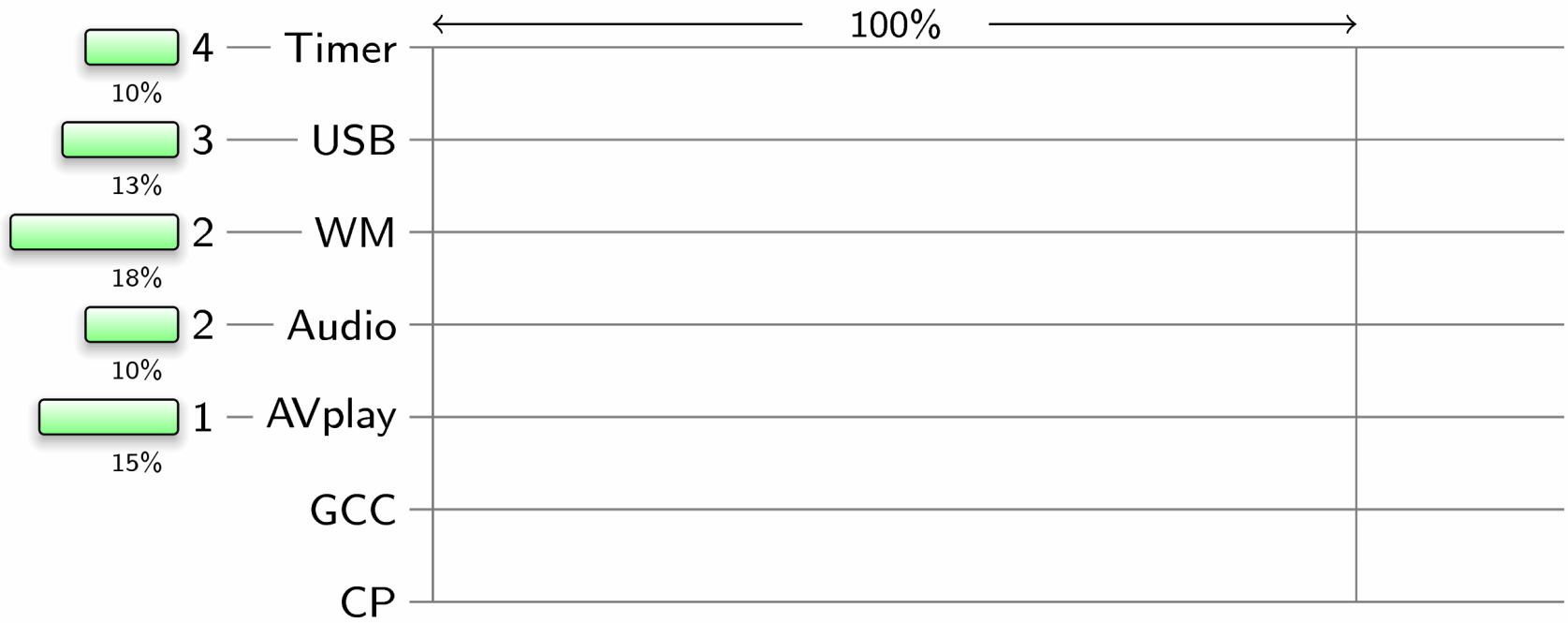
Scheduling

Absolute priorities



Scheduling

Quota-bound priorities



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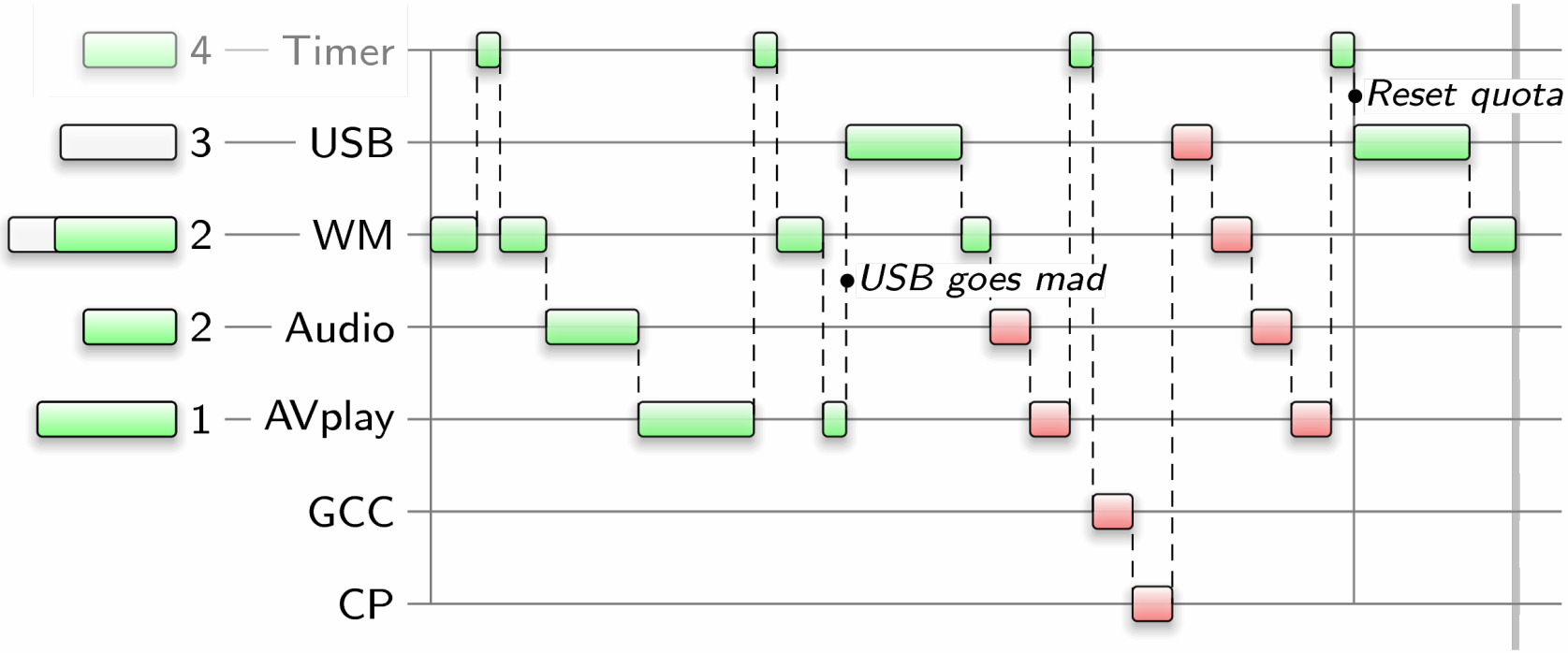
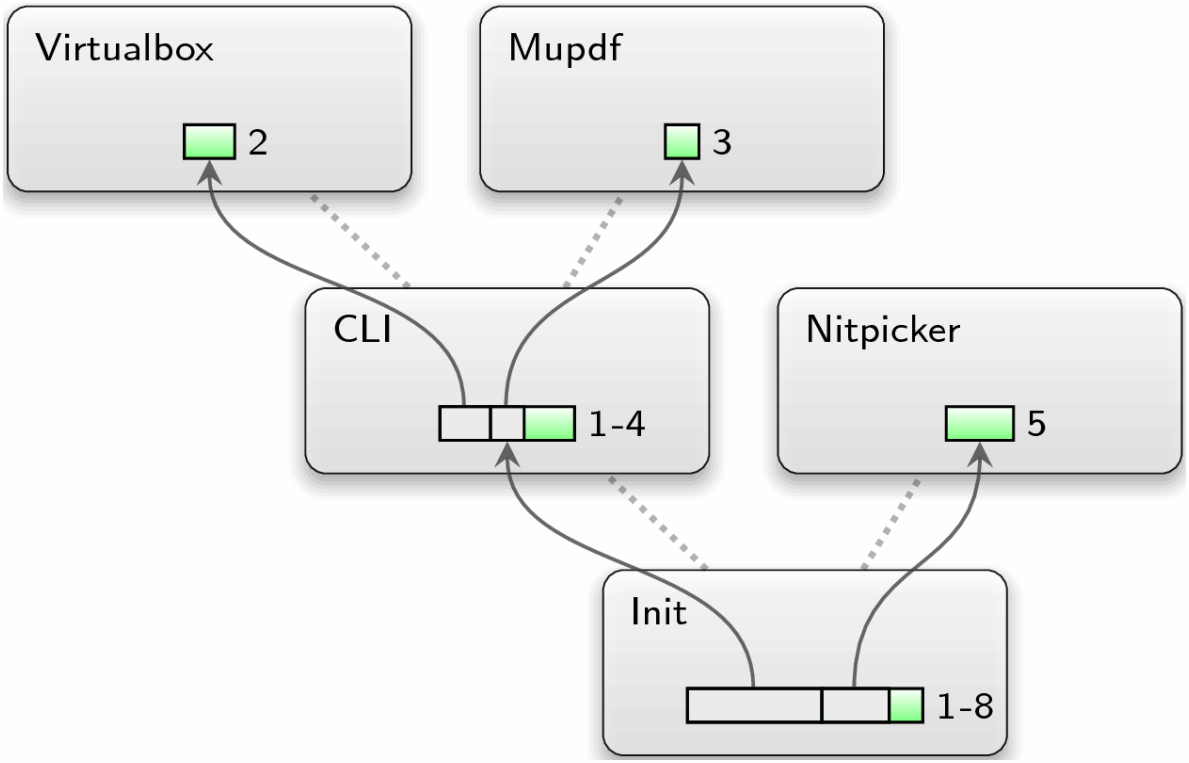


Scheduling

Donation of CPU resources from parents to their children



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Capabilities

- Automatic creation or translation on IPC delegation

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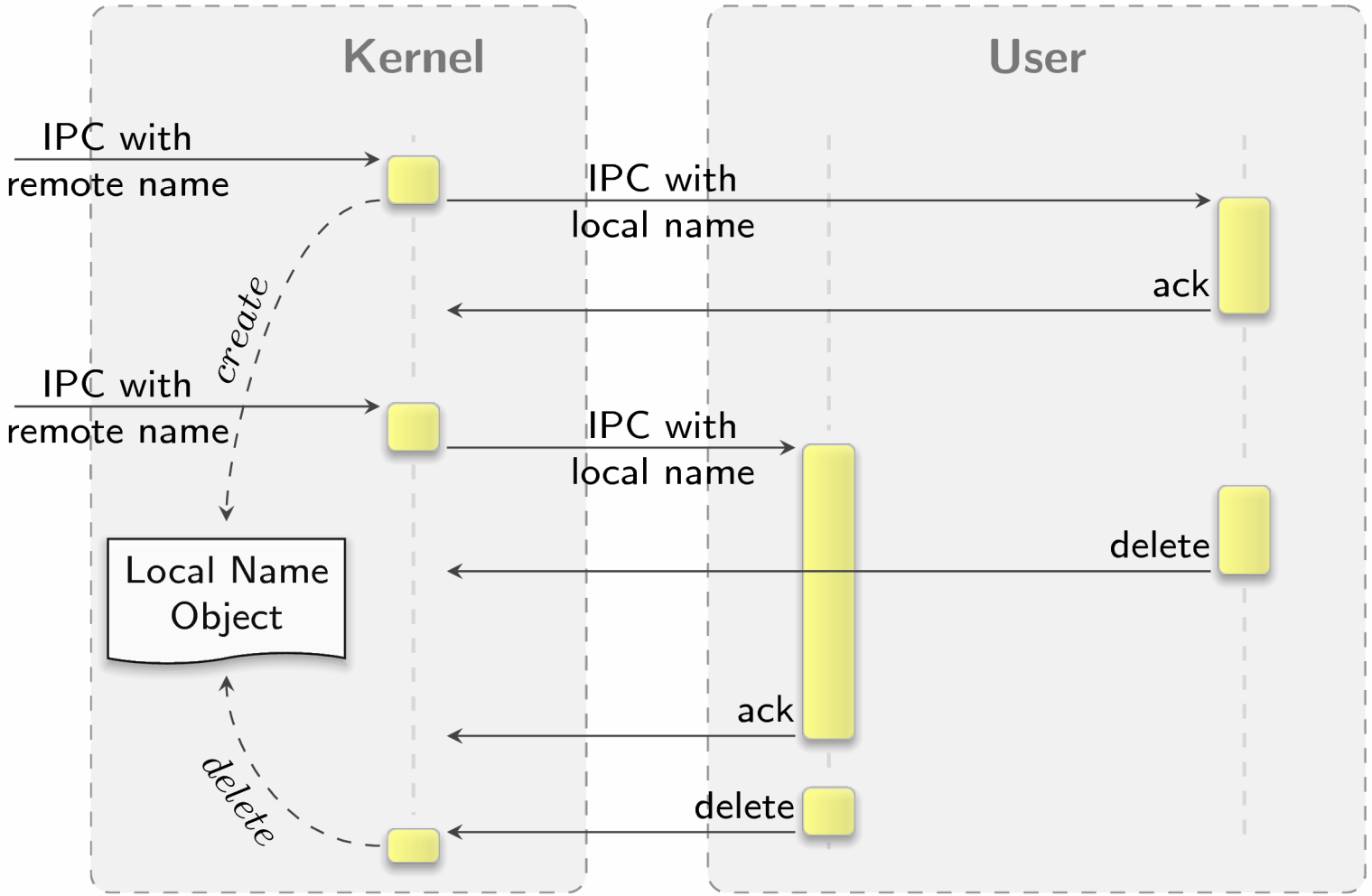
- No name diversity in a PD
- Costs get accounted via PD session quota

Capabilities

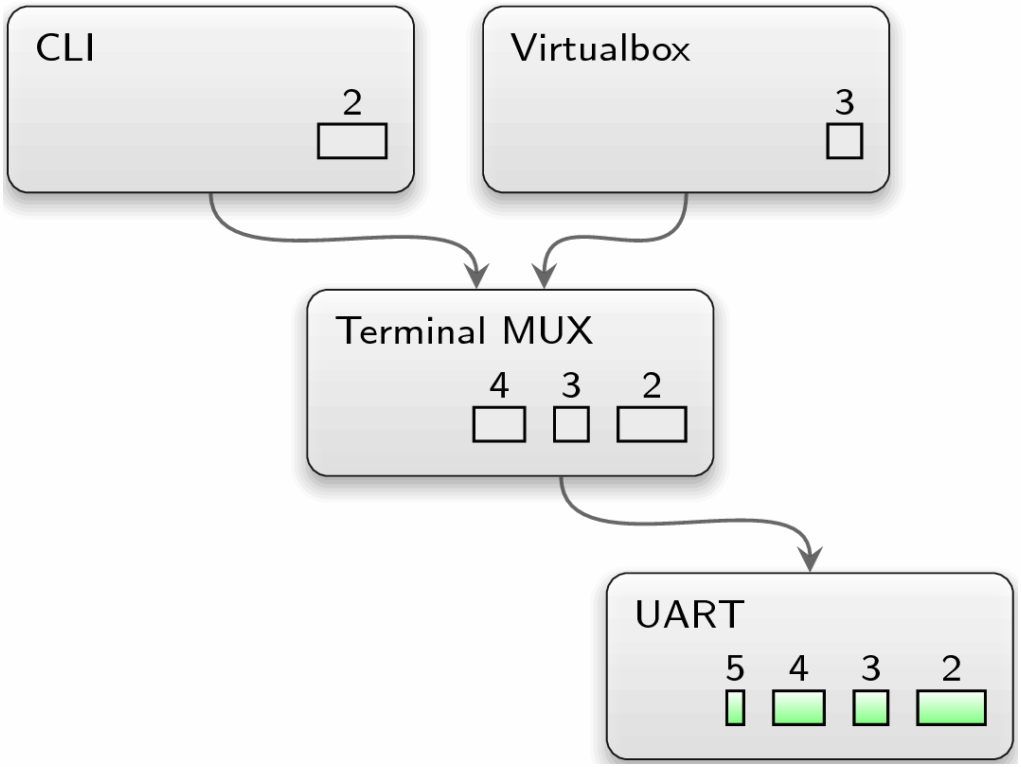
Collaborative lifetime management for Capabilities



Outline

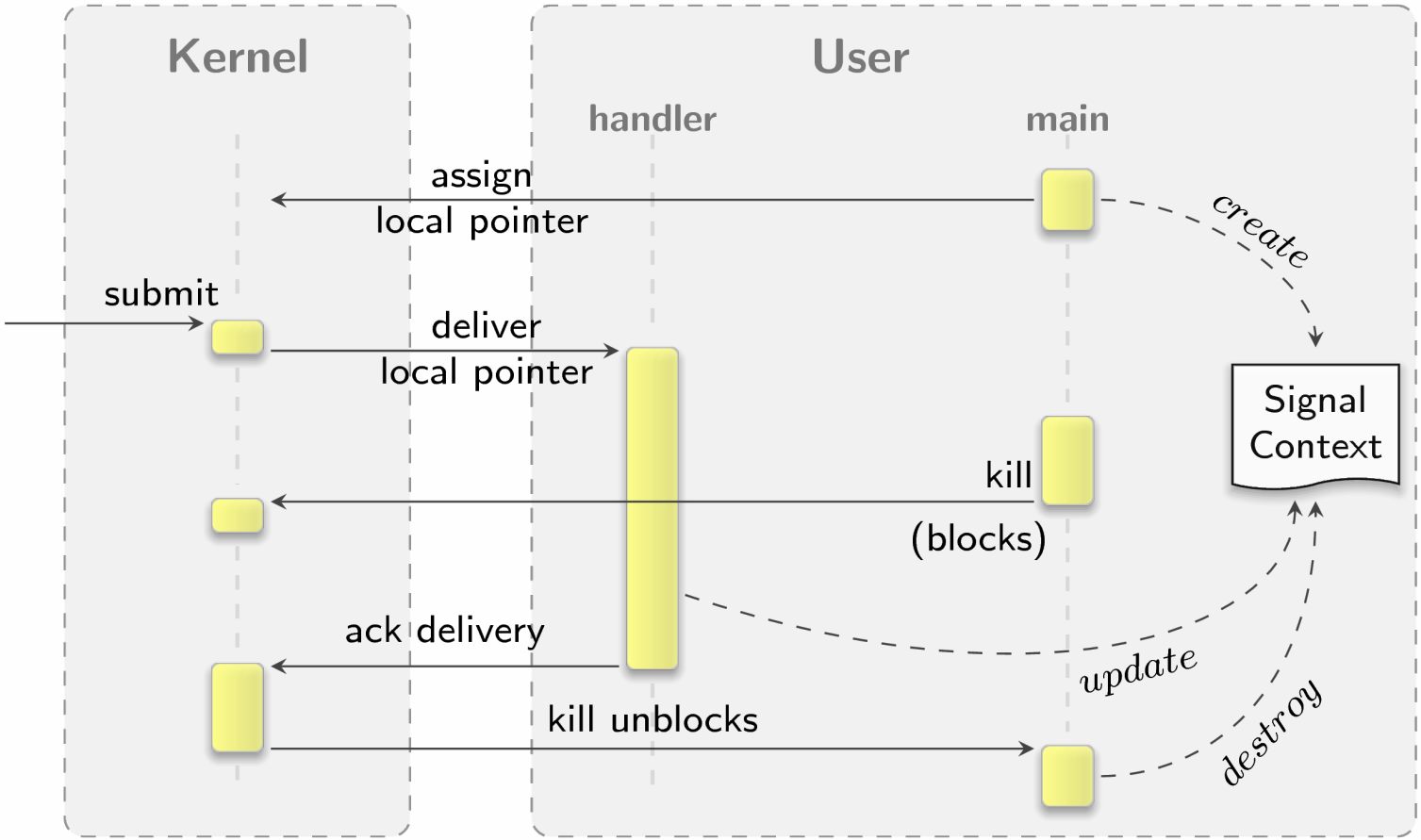
Communication

IPC implicitely delegates CPU resources



Communication

Collaborative lifetime management for Signals



Thank you!

Genode OS Framework

`http://genode.org`

Genode Labs GmbH

`http://genode-labs.com`

Source code at GitHub

`http://github.com/genodelabs/genode`