Will Serverless End the Dominance of Linux in the Cloud?

Ricardo Koller and Dan Williams, IBM Research

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IBM

The beginning of the end of Linux

- “[T]hroughout the history of computer science there has been a fairly constant opinion that current operating systems are inadequate”
  - Engler and Kaashoek 1995

- Why now?

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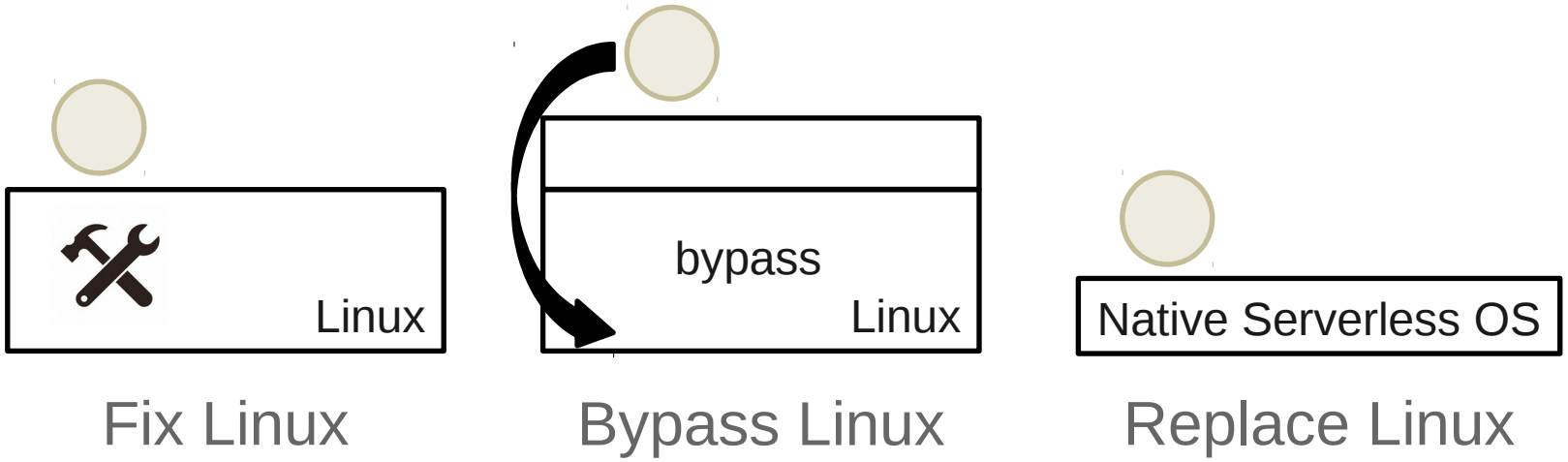
- Why now?
  - Cloud unit of execution shrinking: **serverless**
  - **Complexity** of kernel continues to grow

Options and Roadmap



- ~~Overview~~
- Serverless and its demands
- How Linux containers fail to meet these demands
- Rethinking the kernel

Serverless and its demands

- Isolation for multi-tenancy (excludes native processes)
- Performance

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Latency

User: should launch immediately
Provider: should not require caching complexities

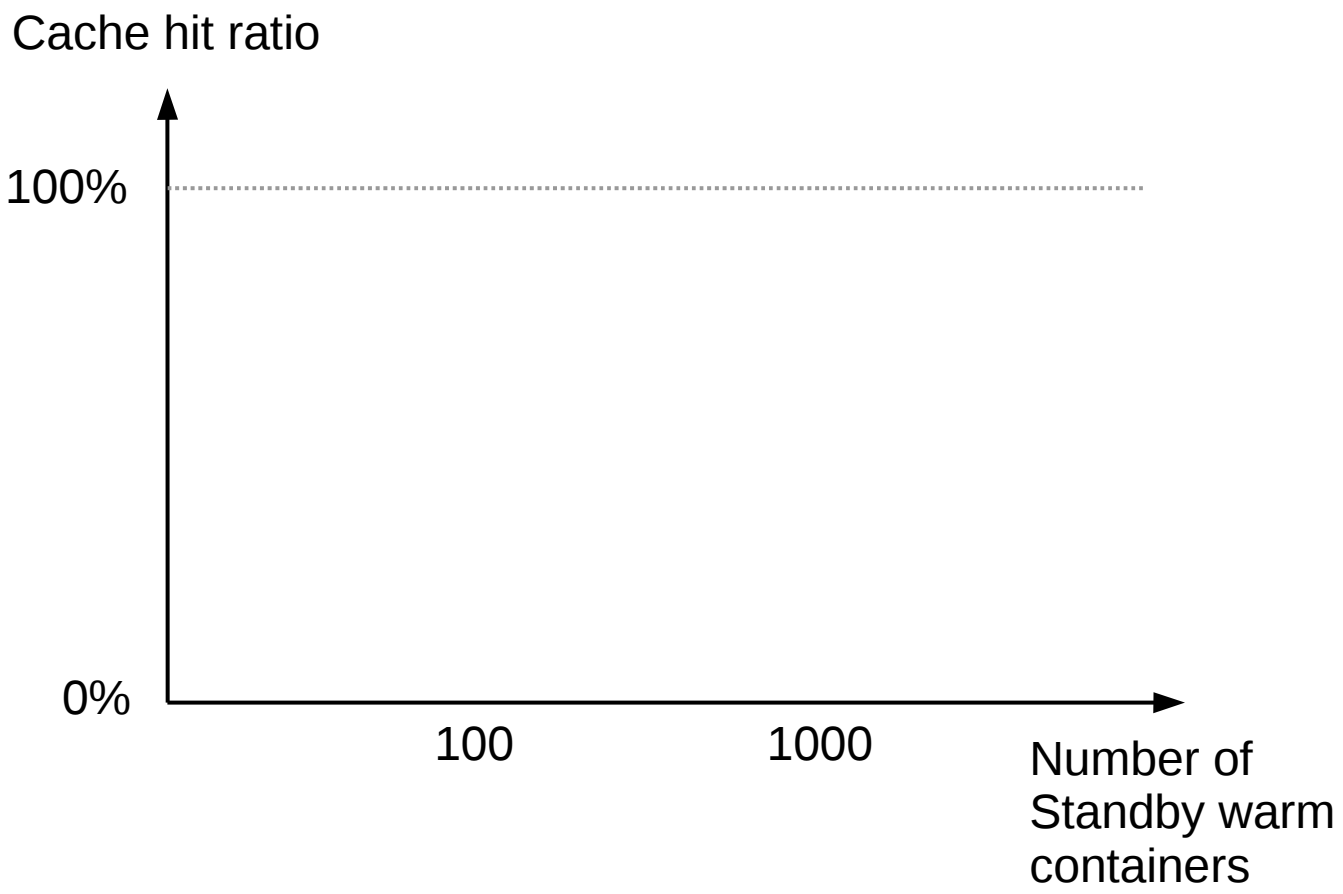
Target: **100 ms**

Throughput

Provider: should at least cover hourly cost of server

Target: **125 actions/sec**

What about caching of warmed containers?



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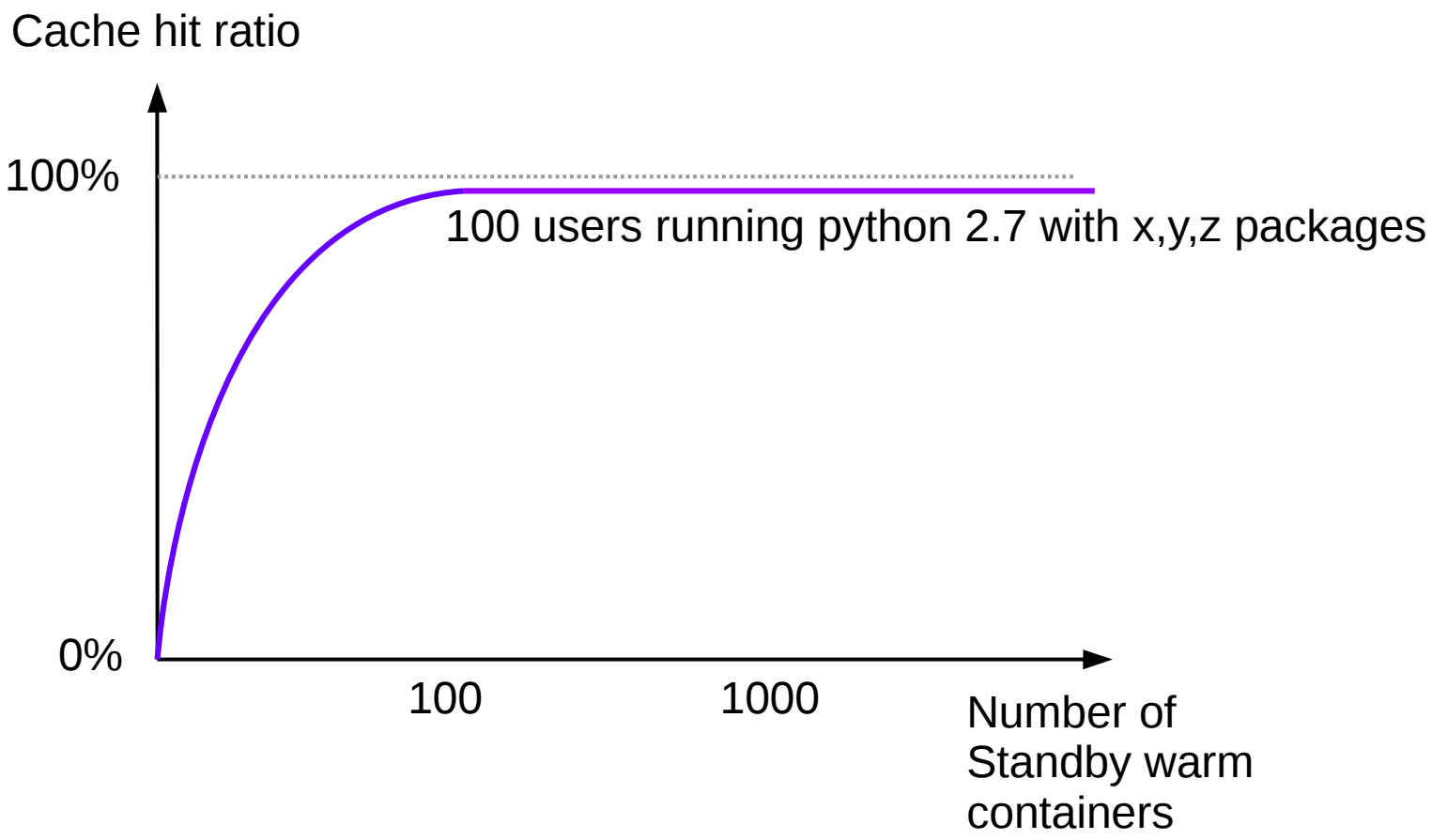

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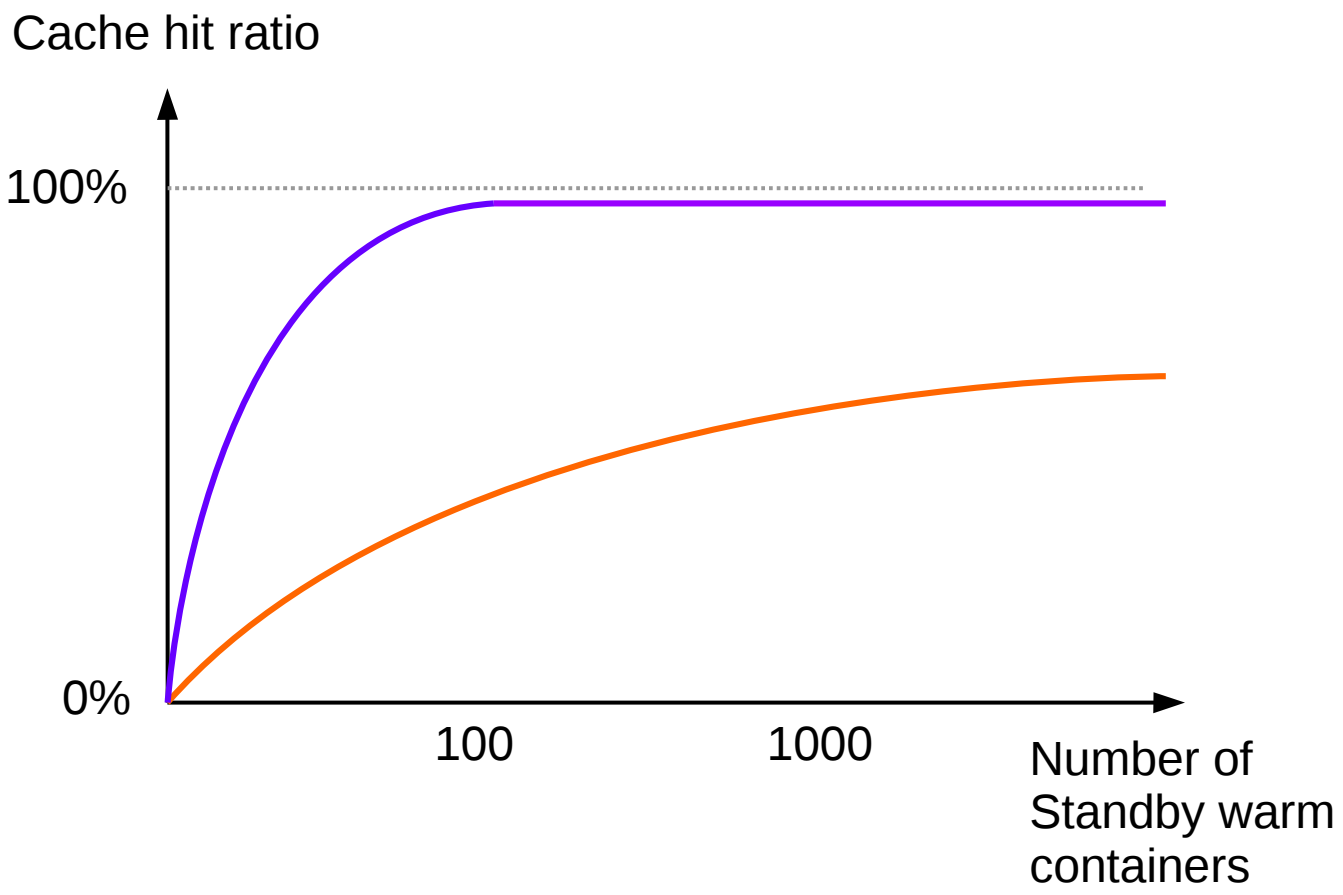
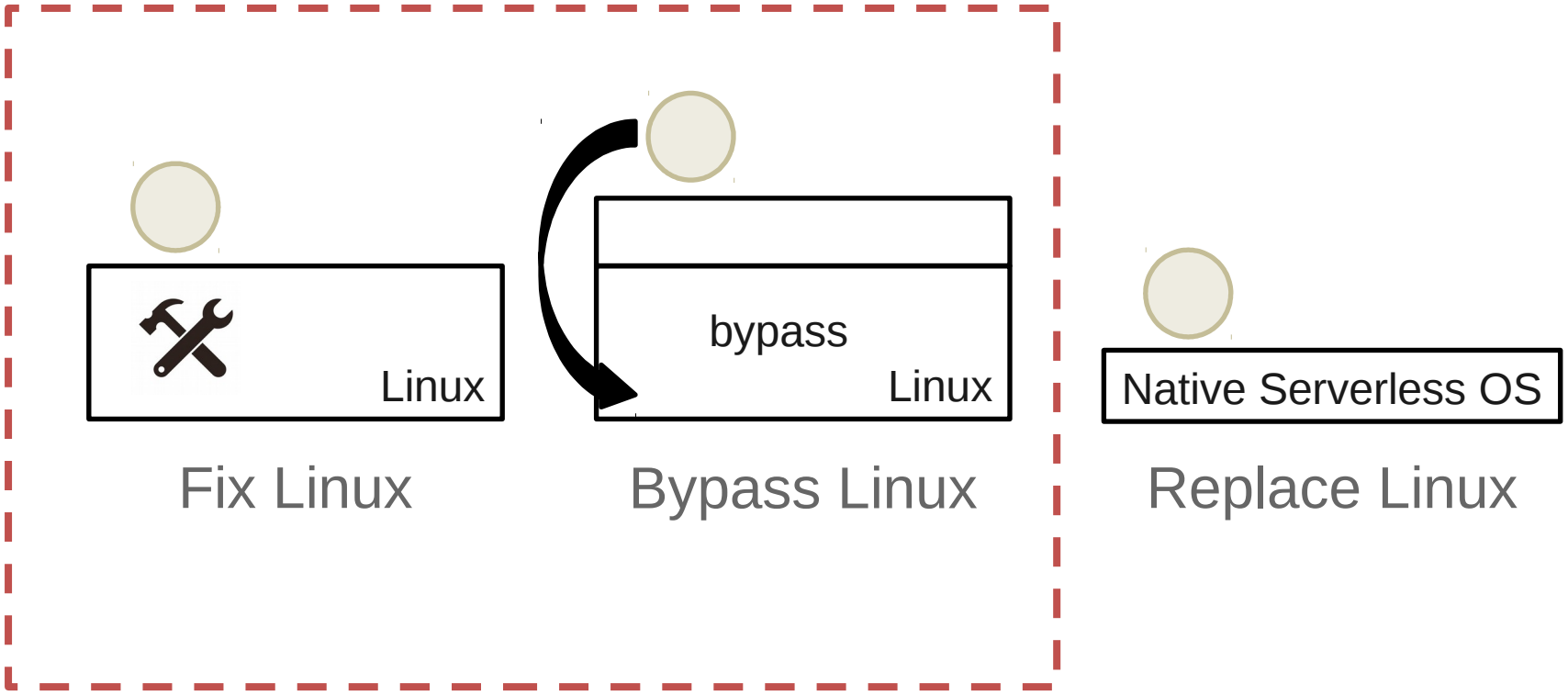


Options Revisited



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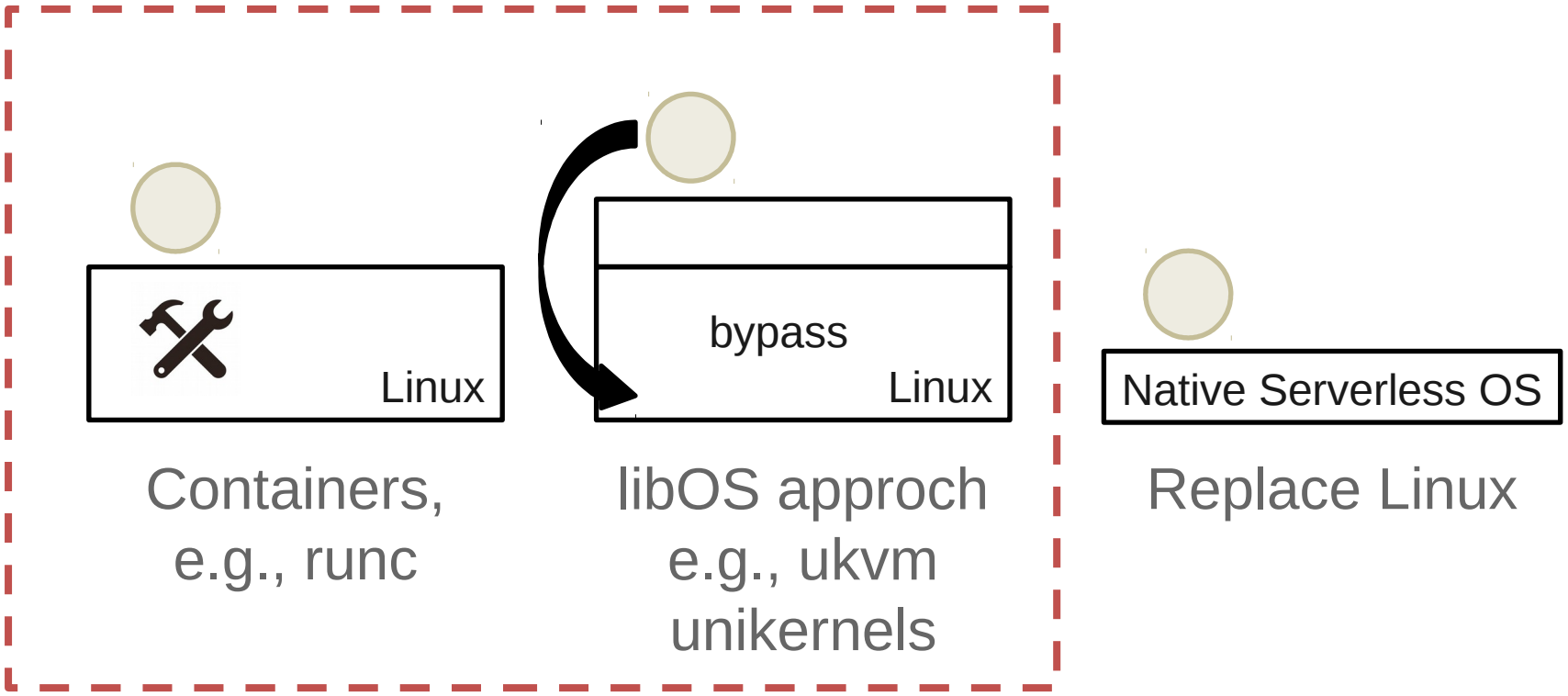
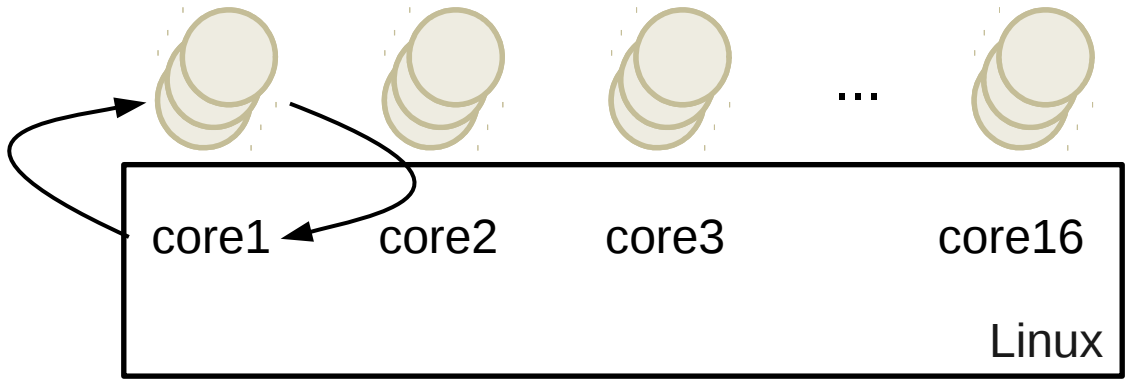


Experimental setup

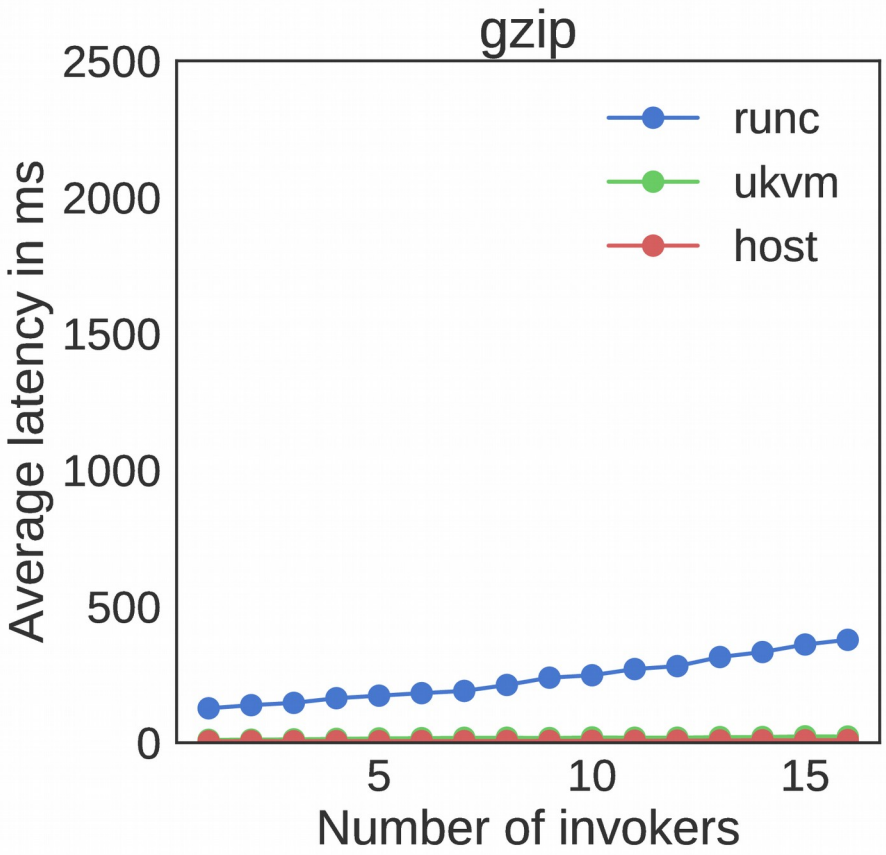


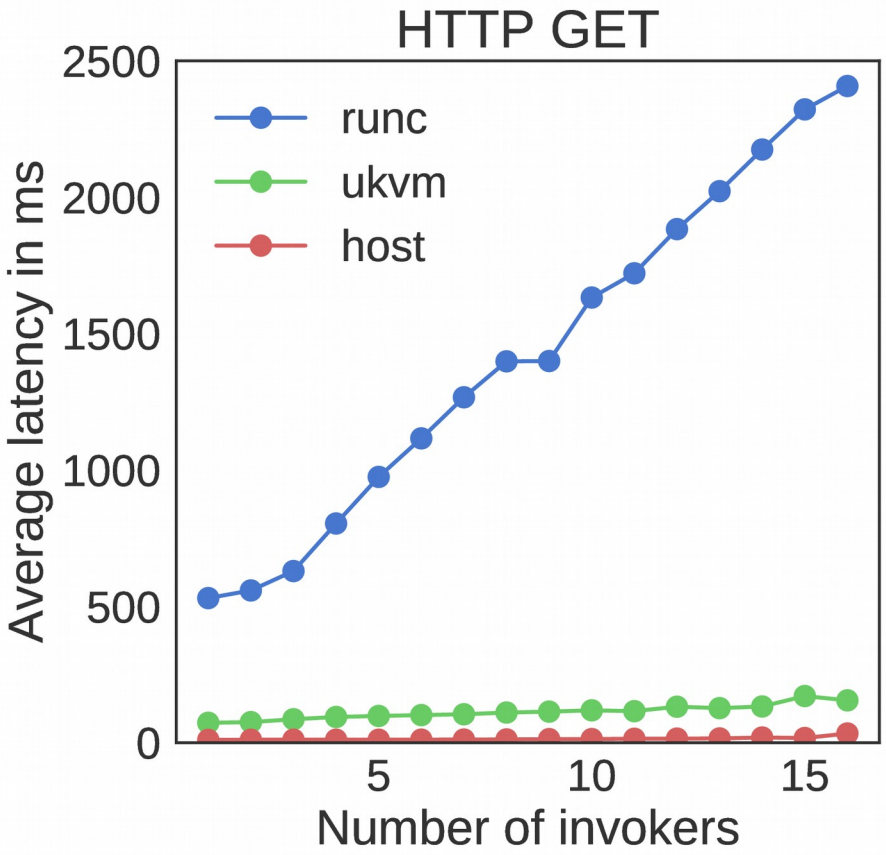
runc container

ukvm unikernel

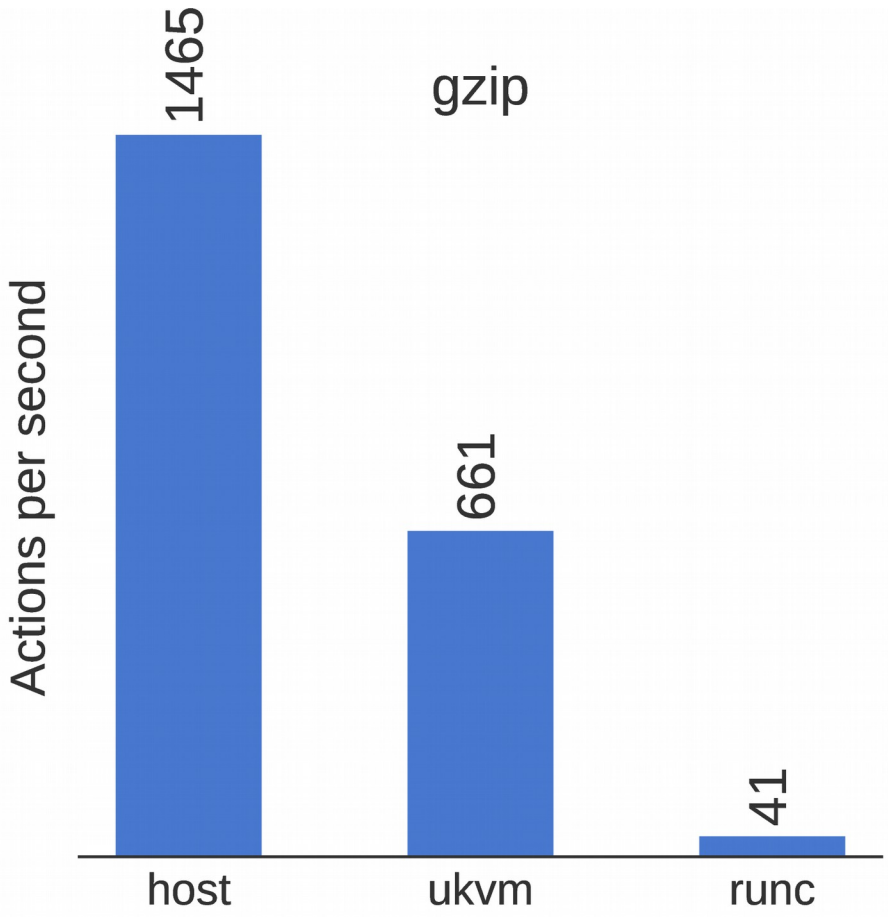
regular host process

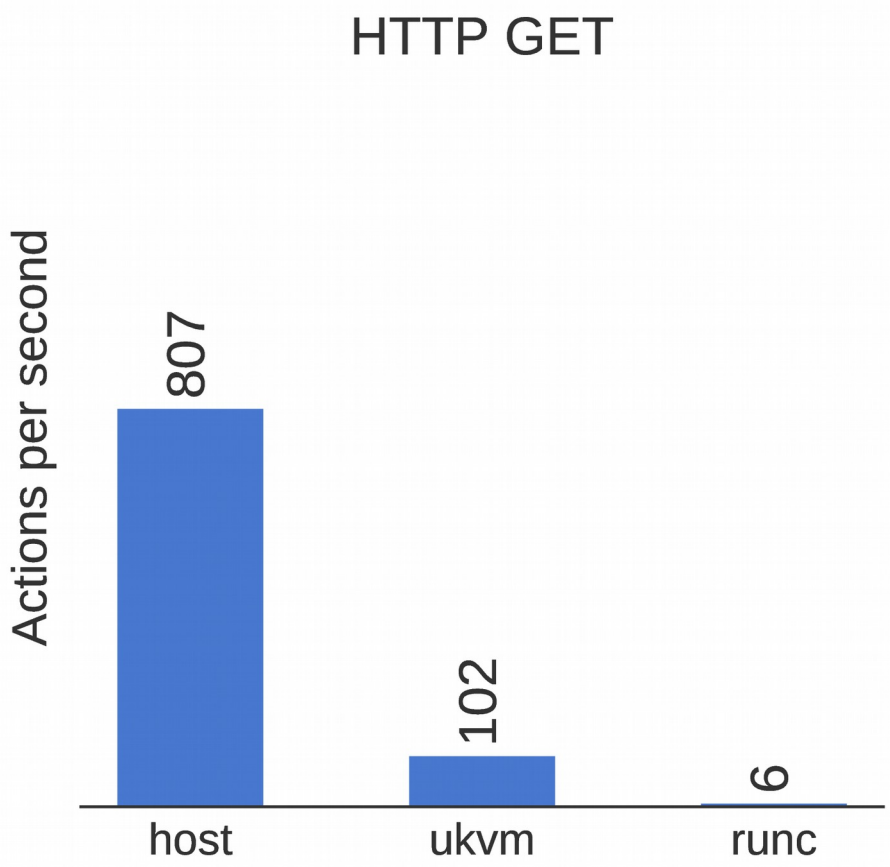
Latency



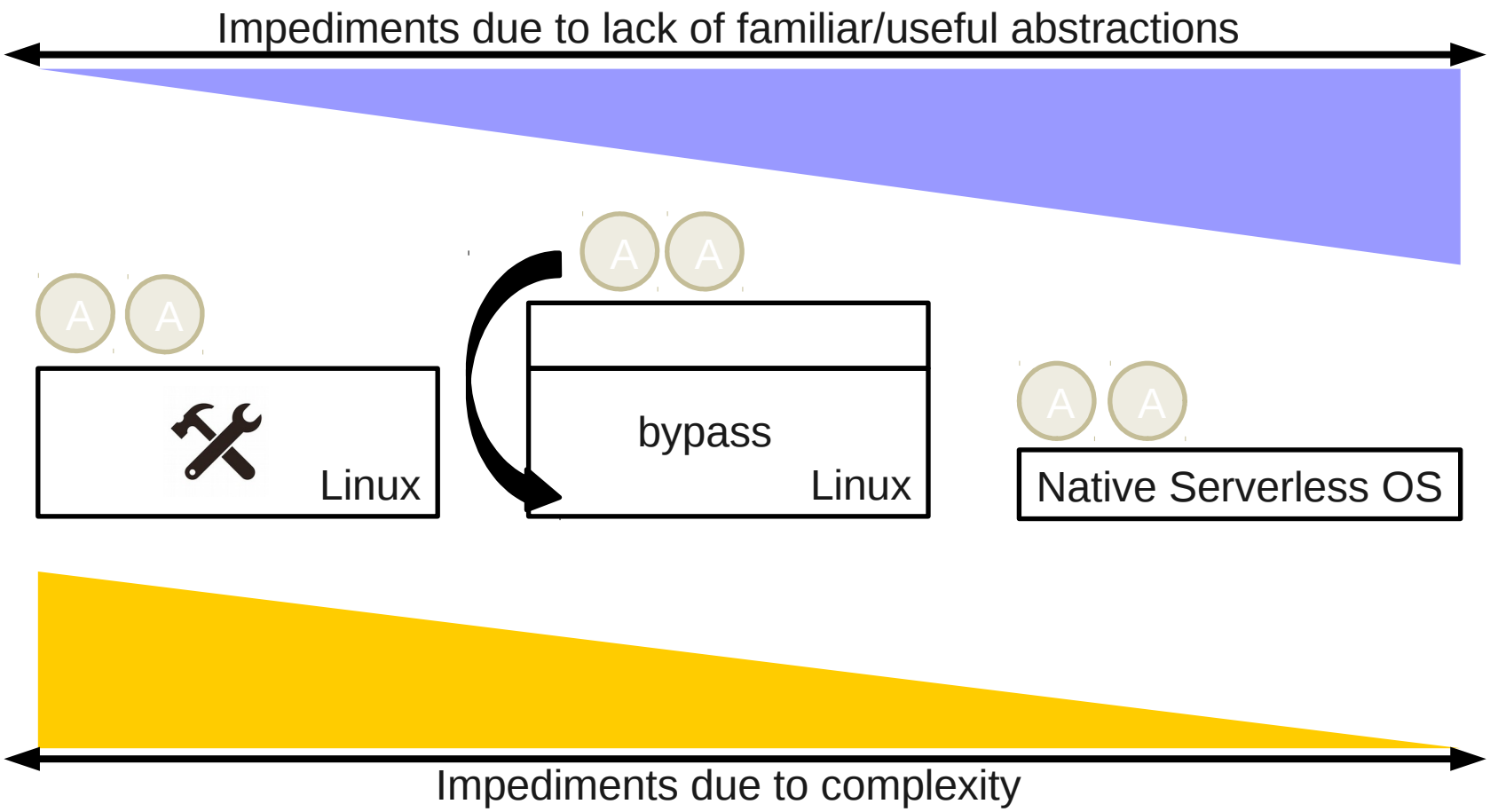


Throughput

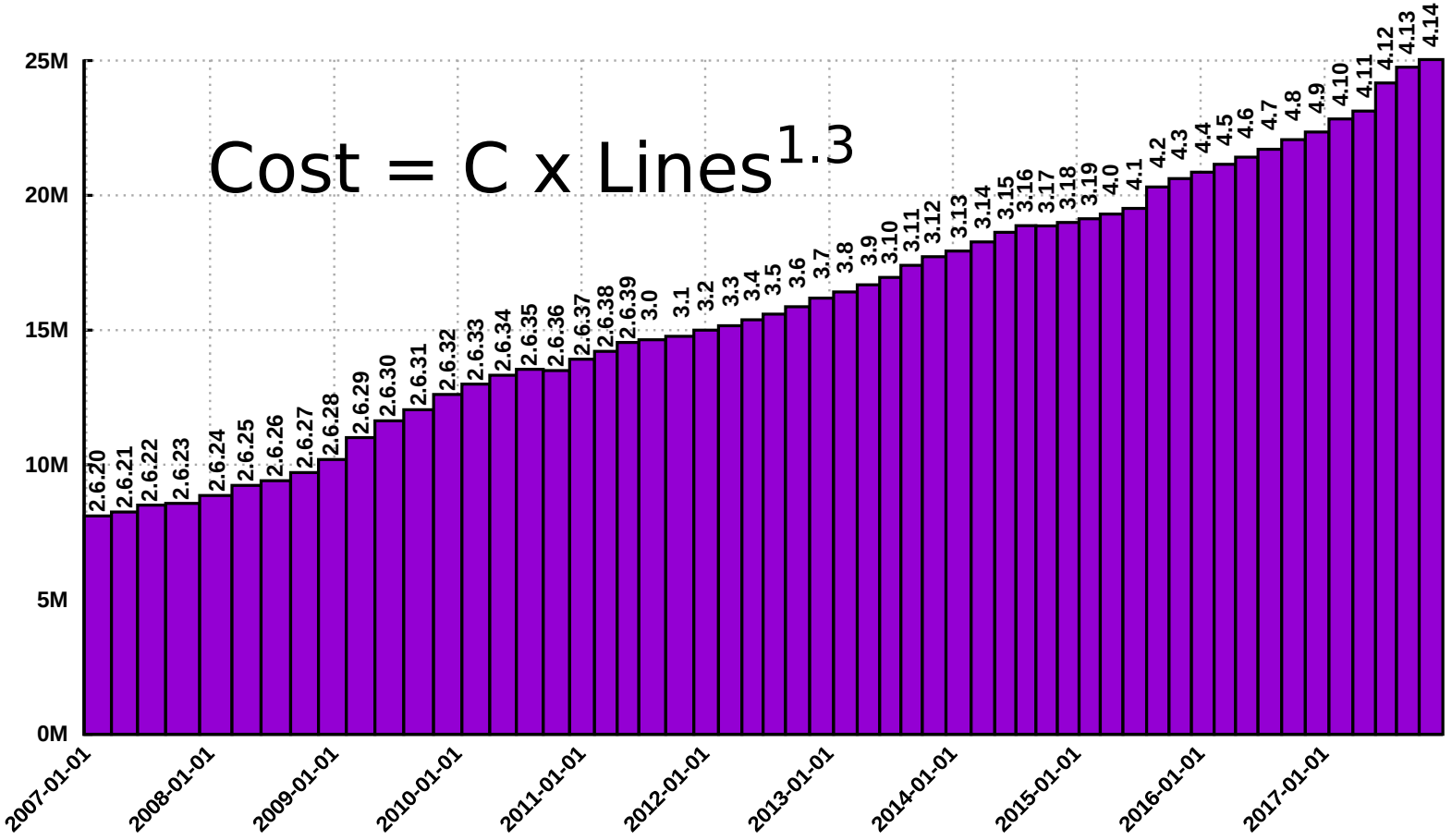




A tradeoff



Can we fix containers?

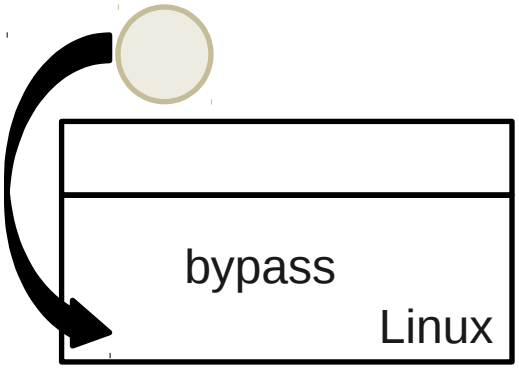


[1] https://upload.wikimedia.org/wikipedia/commons/1/11/Lines_of_Code_Linux_Kernel.svg

[2] The Linux kernel as a case study in software evolution. Journal of Systems and Software 83, 3 (2010)

If we choose to bypass Linux…

- Linux is just used for setup
  – “the OS is the control plane”
- We would prefer that the kernel **stop trying to adapt** to cloud workloads
- We should choose to **design** for bypass



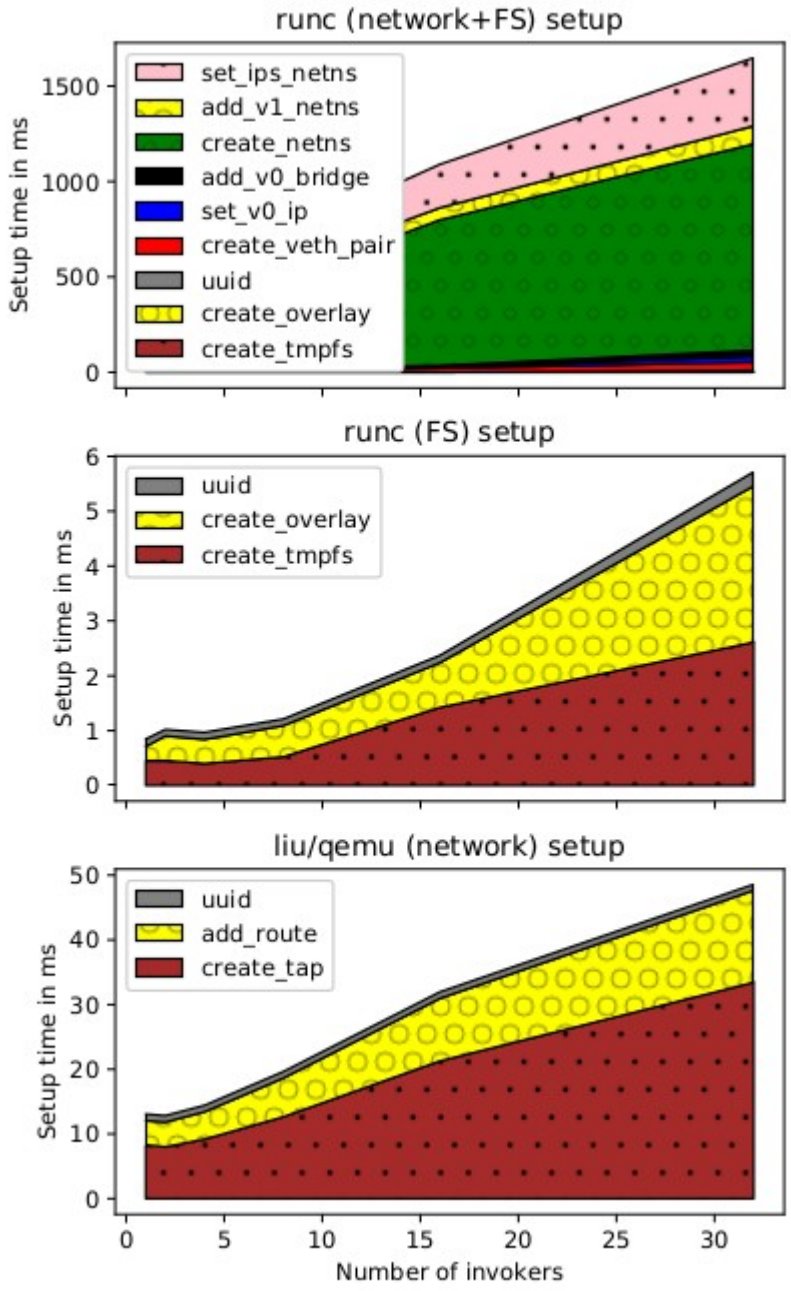
Bypass Linux

If we choose to replace Linux…

- No preemptible scheduling
  - actions are short and run-to-completion
- No process synchronization
- No IPC (inter-process communication)
- Limited set of I/O calls: literally input and output
  - files are unnecessary abstractions

Conclusions?

- Native abstractions in Linux (containers) are not suitable for serverless at this time
- Can they be fixed?
- Should we bypass Linux?
  - Then we should design for bypass
- Is it time to replace Linux? Can that even happen?



Cold starts