System Efficiency as Carbon Awareness(?)

Michio Honda
University of Edinburgh
Carbon Aware Networks Workshop 2023
20 September, 2023, Oxford

michio.honda@ed.ac.uk

THE UNIVERSITY of EDINBURGH
informatics

With acknowledge to my group members: Tianyi Gao, Steven Chien and Shuo Li

Carbon aware techniques

Policies/frameworks

Routing/TE

Cloud orchestration

NF placement

5G/6G infra.

System software

OS/HW

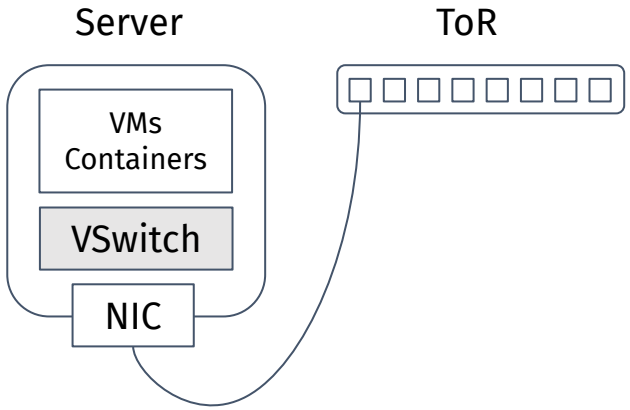
CPU/Memory governors

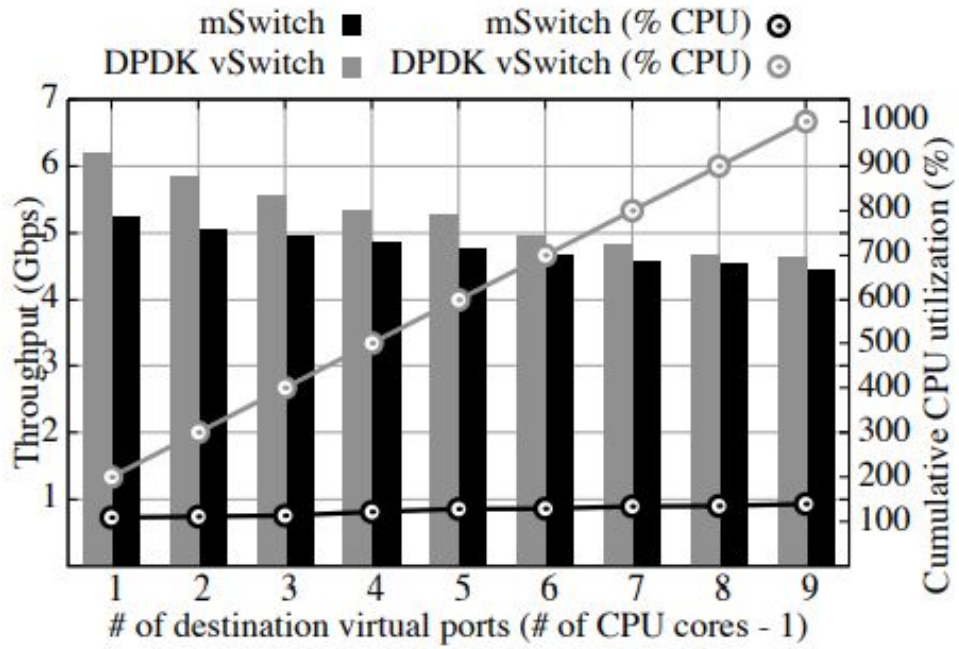
Scheduler

CPU state (DVFS)

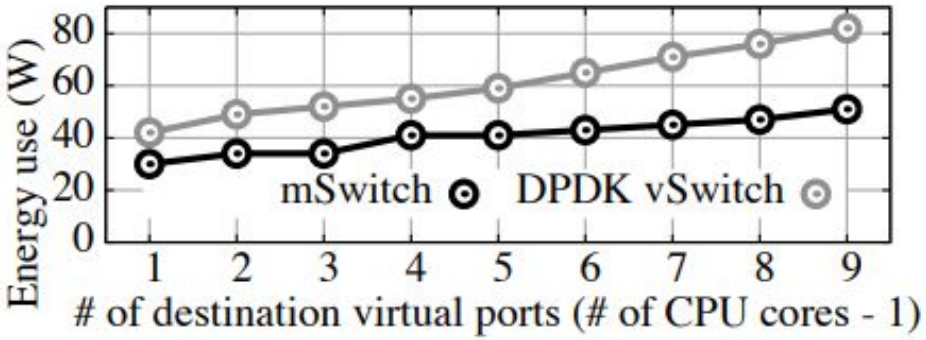
Virtualization

- DPDK is unlikely an option
  - Busy polling wastes CPU cycles for nothing
  - Telco and cloud operators would save half of the server energy





(a) mSwitch versus DPDK vSwitch

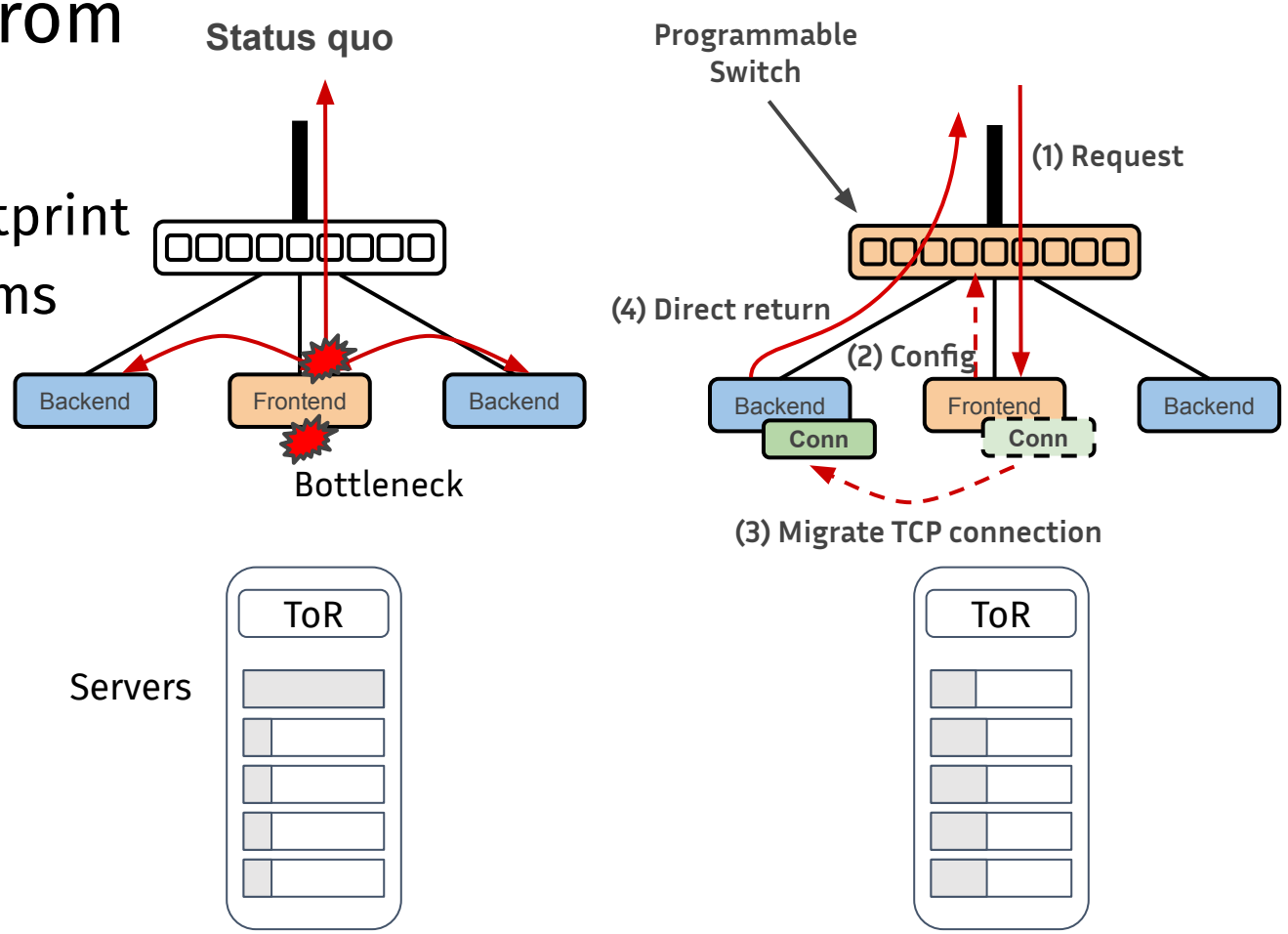


(b) Power consumption

M. Honda et al, mSwitch: A highly scalable, modular software switch, ACM SOSR'15

Server scale out

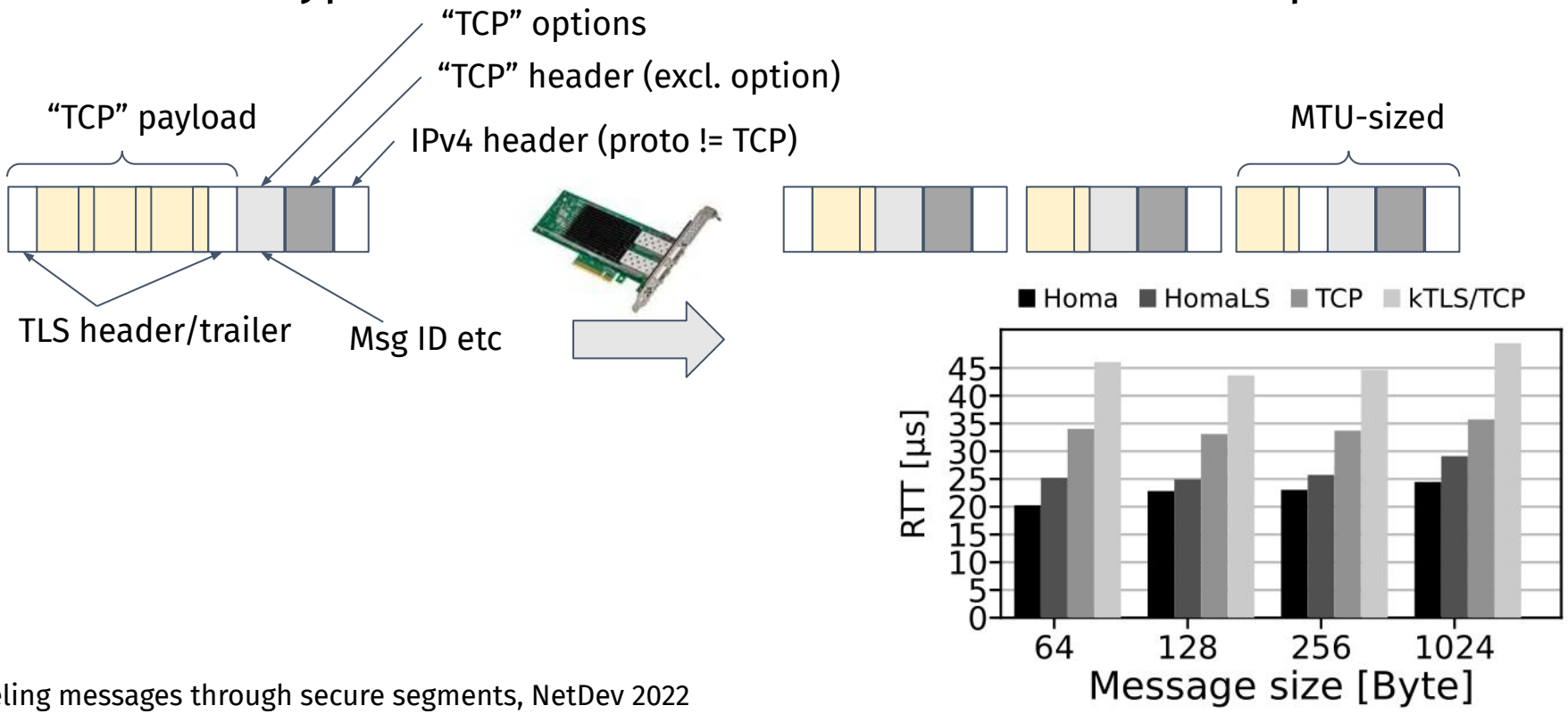
- Proxy-based systems suffer from low rack resource utilization
  - Increase the space and energy footprint
  - Common in web and storage systems



Y Hayakawa et al, Prism: Proxies without the Pain, USENIX NSDI'21

Encryption

- Encryption consumes a lot of datacenter energy
  - AVX instructions are power hungry
  - Transport-level encryption with hardware offload would be an option to reduce it



T. Gao et al, HomaLS: Tunneling messages through secure segments, NetDev 2022

Towards carbon aware networking

- No DPDK/SPDK
  - Kernels handle interrupts better
  - netmap [ATC'11] / AF_XDP
- Minimize data detouring and transformation
  - Proxying comes at significant machine costs
  - Prism [NSDI'21]
- Transport-level encryption at the NIC would be power efficient
  - CPU instructions are often power hungry