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Descartes
research

Comparison between Polling- and Interrupt-based Packet Processing Regarding Performance and Power Efficiency

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https://se.informatik.uni-wuerzburg.de

Motivation

- Packet processing devices and applications face different requirements
- Especially clear contrast in DDoS defense systems

Under high load conditions:

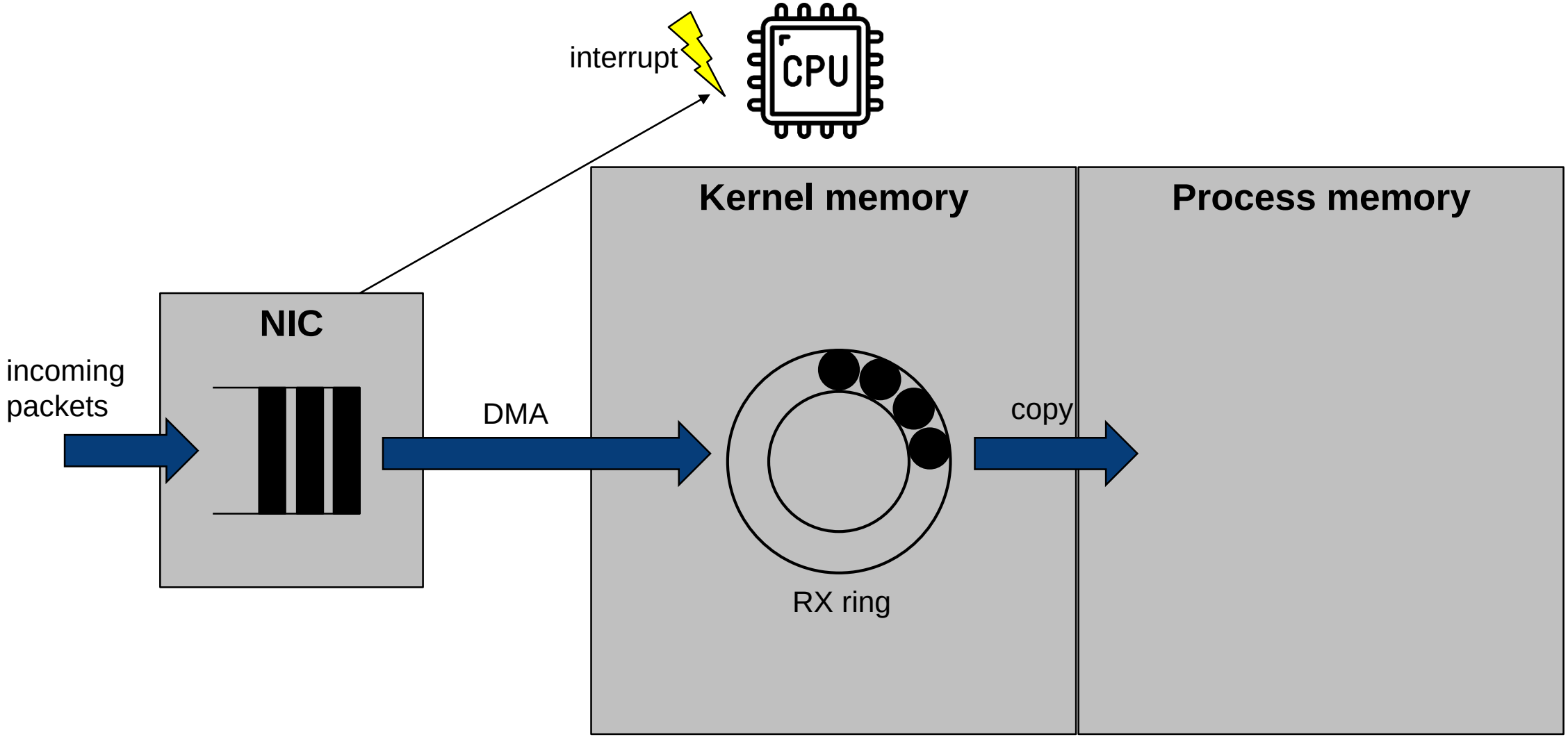
- Throughput should be as high as possible to minimize packet loss
- Small percentage of overall runtime (hopefully)
- Power consumption secondary

Under low and medium load conditions:

- Throughput can easily be processed
- Most of the time spent in these scenarios
- Power consumption should be kept minimal

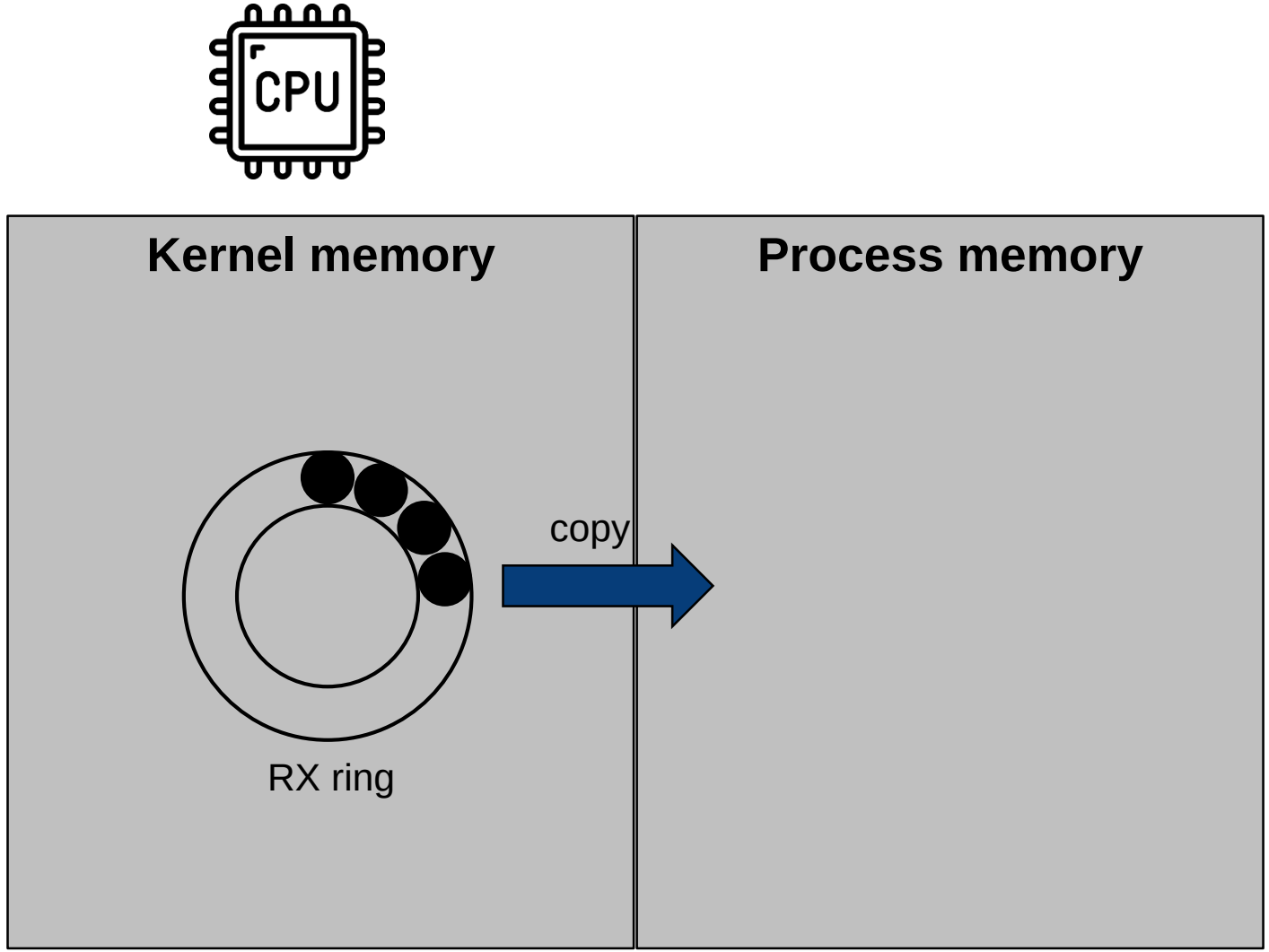
In this talk: Enabling technologies and measurement results

Linux Kernel Networking



Linux Kernel Networking

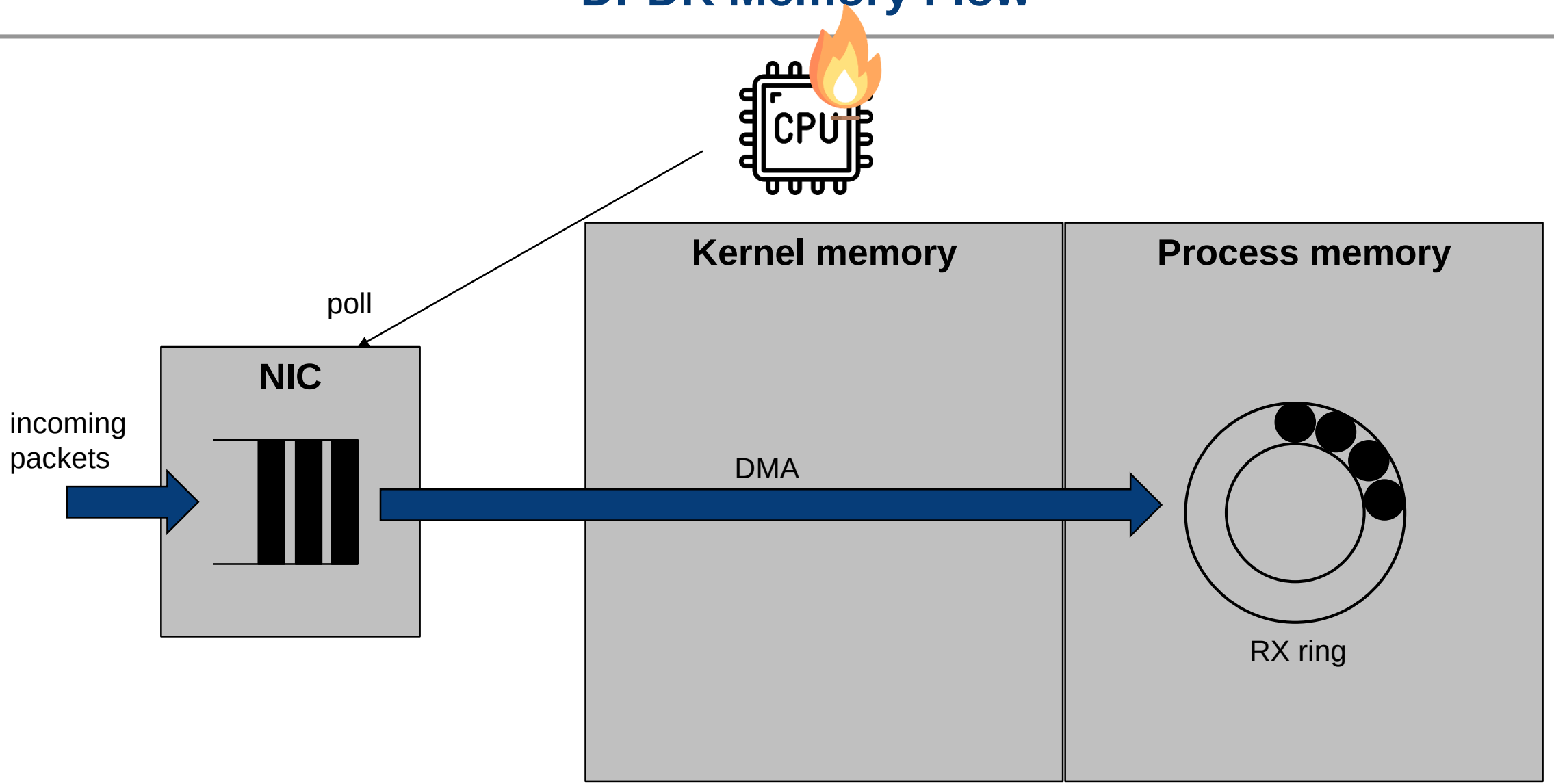
- Works well for every day networking
- Overhead caused by
  - Interrupt-induced context switches
  - Memory coyping
- Limited throughput



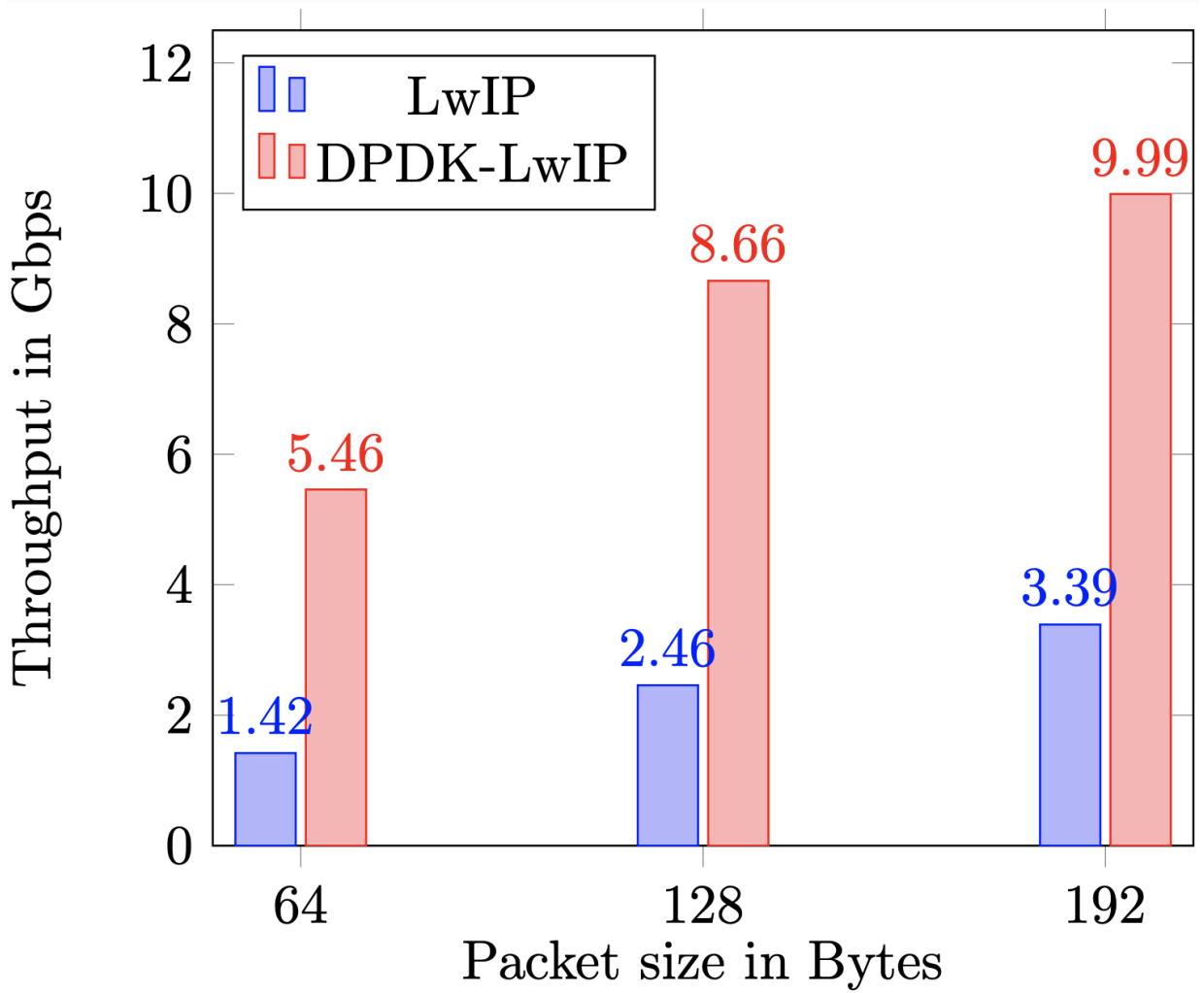
Intel DPDK

- Library to accelerate packet processing workloads
- Uses poll-mode, userspace NIC drivers

DPDK Memory Flow



Kernel Networking vs. DPDK



"Integration of LwIP Stack over Intel(R) DPDK for High Throughput Packet Delivery to Applications"
R. Rajesh, K. B. Ramia, and M. Kulkarni

Intel DPDK

- Library to accelerate packet processing workloads
- Uses poll-mode, userspace NIC drivers **– but also offers interrupts!**

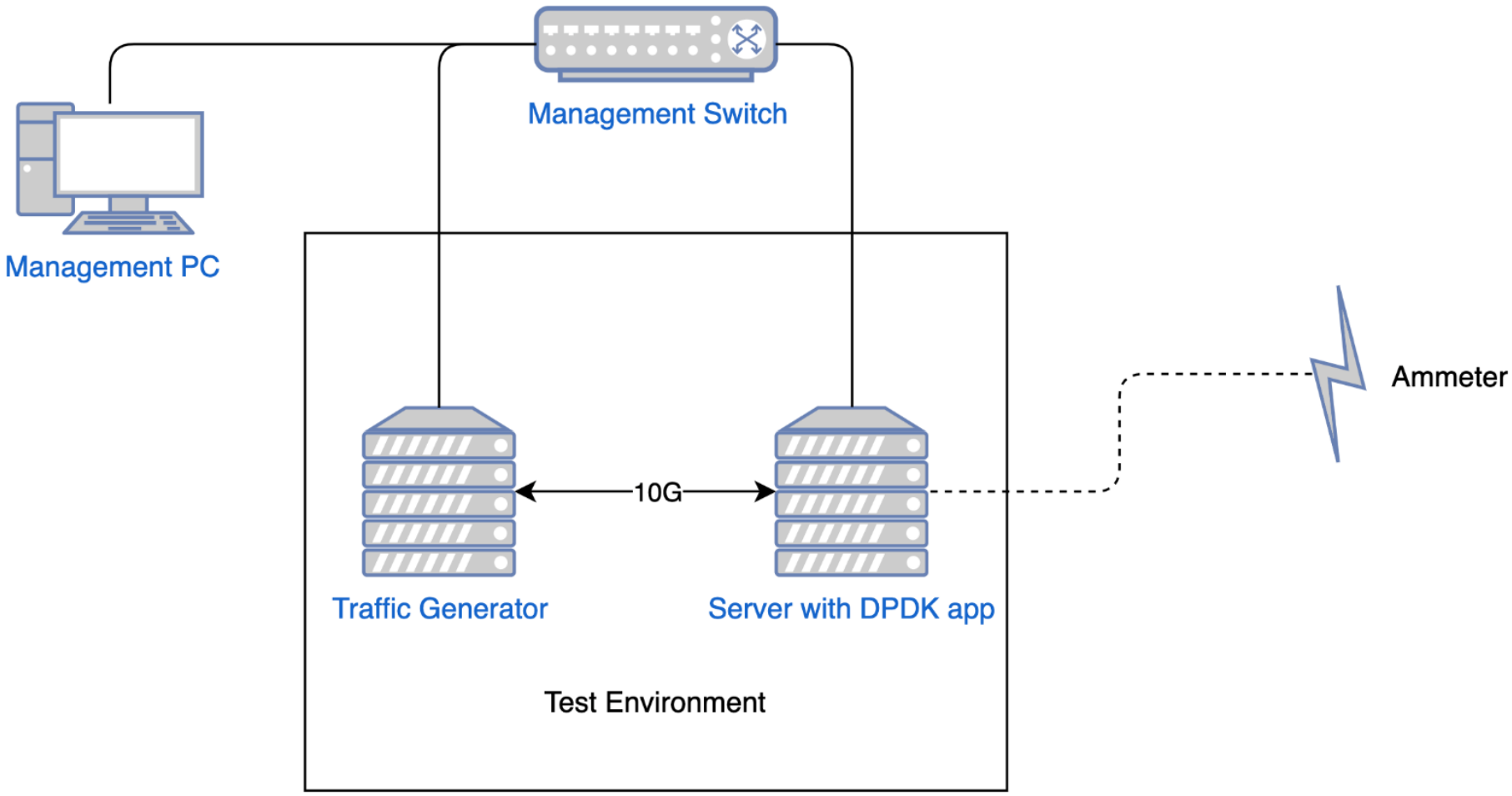
Research Questions and Approach

- Research questions
  - RQ1: Is there/how bad is performance loss when using interrupts?
  - RQ2: Under which conditions can interrupts reduce power consumption? By how much?

- Approach
  - Base is a DPDK-based SYN flood protection network function (presented at SSP 2018)
  - Modify to switch to interrupt-based processing at low loads
  - Compare throughputs
  - Compare power consumption

Testbed

- Intel Xeon E5-2420
  - 6 cores
  - 12 threads
  - 1.9GHz
  - 2.4GHz boost
- 10G network SFP+ connection



Throuhput Measurements

- Traffic generator sends SYN packets near 10G line rate (14.88 Mpps)
- Measure packet loss over 5 seconds → ~74.4 million packets

- Polling: avg. of 287.660 packets missing (0.39%)
- Interrupt: avg. of 378.680 packets missing (0.51%)

With CPU clock speed reduced to 1.2GHz:

- Polling: avg. of 32.957.540 packets missing (44.3%)
- Interrupt: avg. of 34.225.994 packets missing (46.0%)

Power Measurements

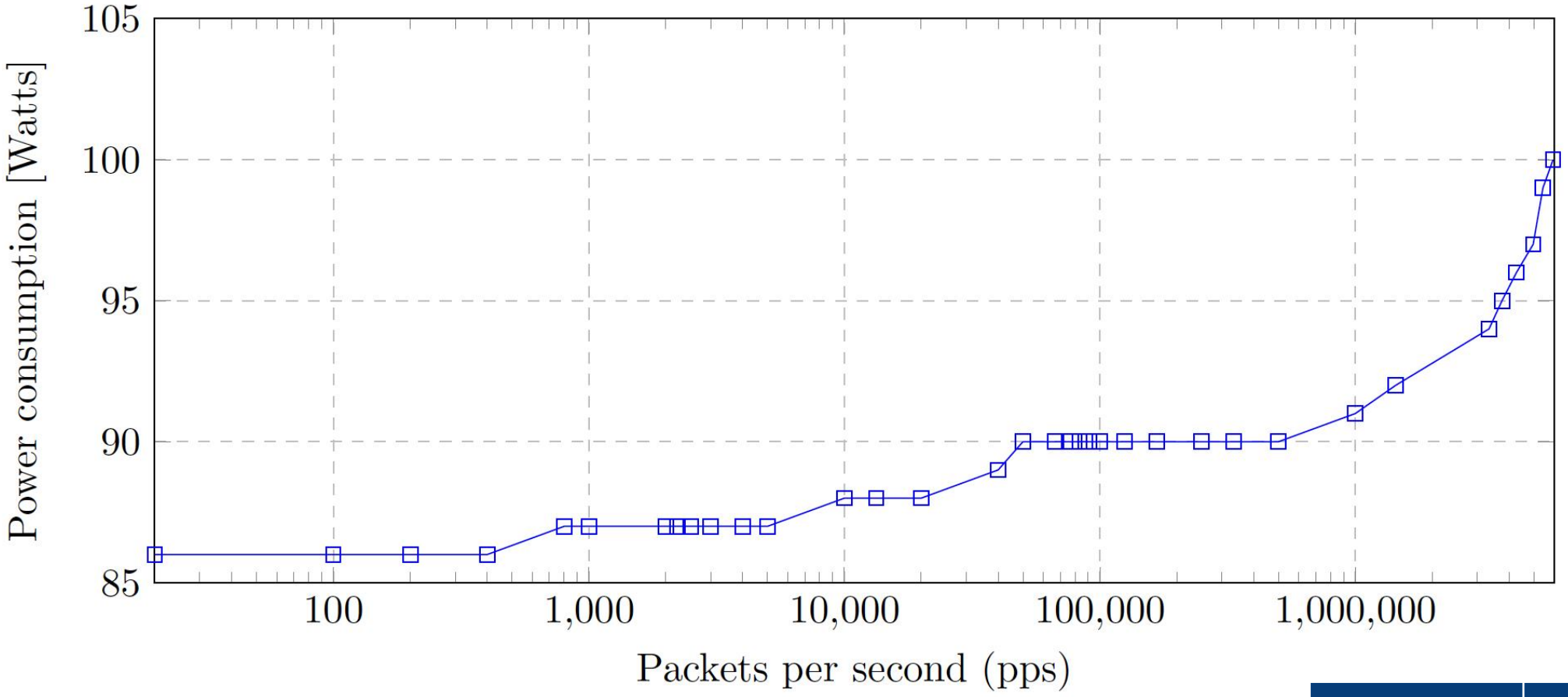
CPU under synthetic load:

State	Power Consumption
Idle	86W
1 thread (full load)	100W
2 threads (full load)	105W
3 threads (full load)	110W
4 threads (full load)	114W
5 threads (full load)	118W
6 threads (full load)	122W
12 threads (full load)	124W

DDoS VNF running:

	Polling	Interrupt
Idle	100W	86W
Full load	101W	100W

Power Measurements



	Polling	Interrupt
Idle	100W	86W
Full load	101W	100W

Conclusion

- Power savings are quite remarkable, especially under moderate load conditions
  - Up to certain packet rates no difference compared to idle mode
  - Only at very high packet rates same power consumption as polling variant

- No strong drawbacks under high load conditions

- Remark: Moderate implementation effort

Thank you for your attention!