Generic Concurrency Restriction

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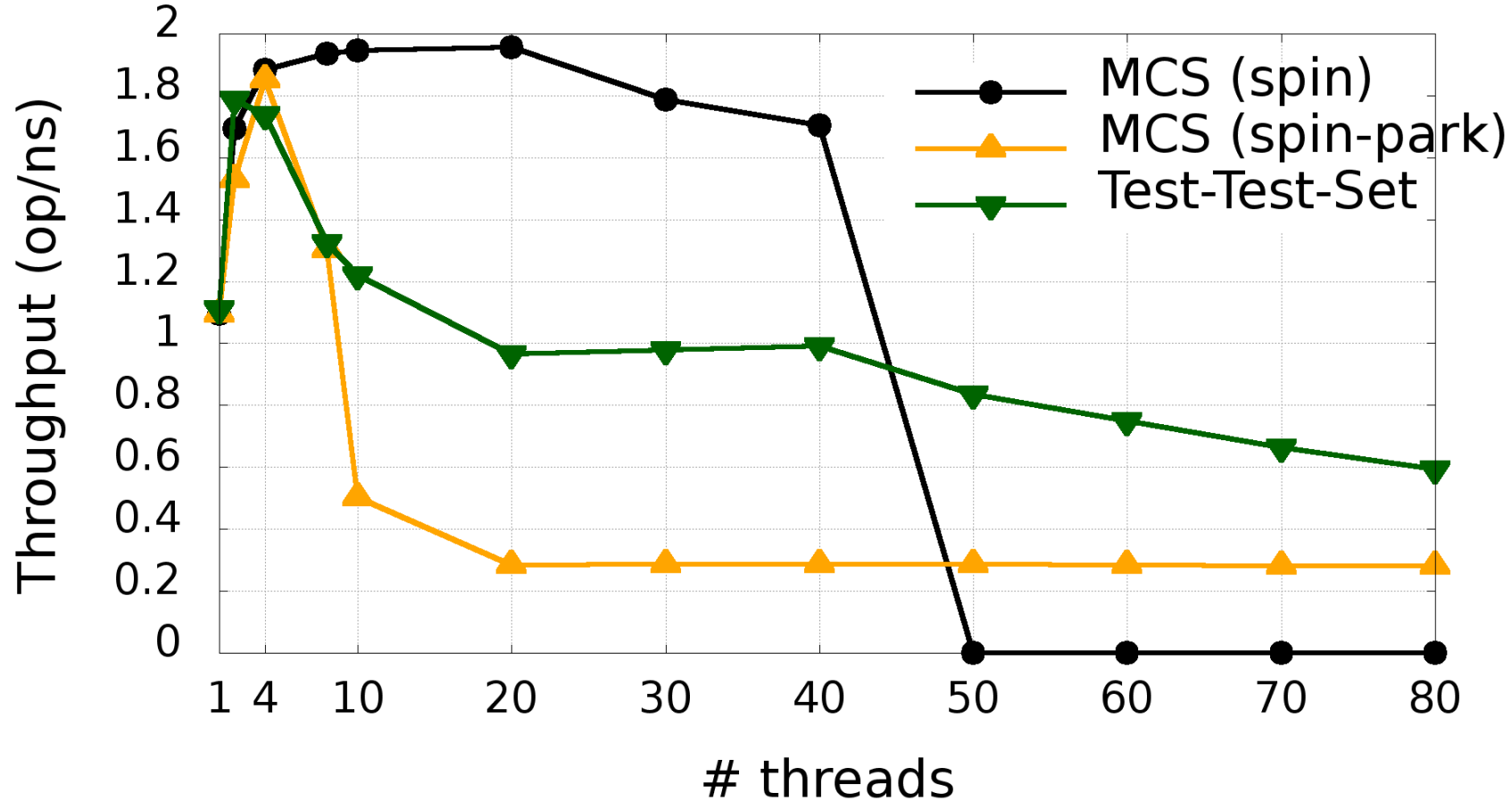
joint work with Dave Dice

The Scalability Collapse problem

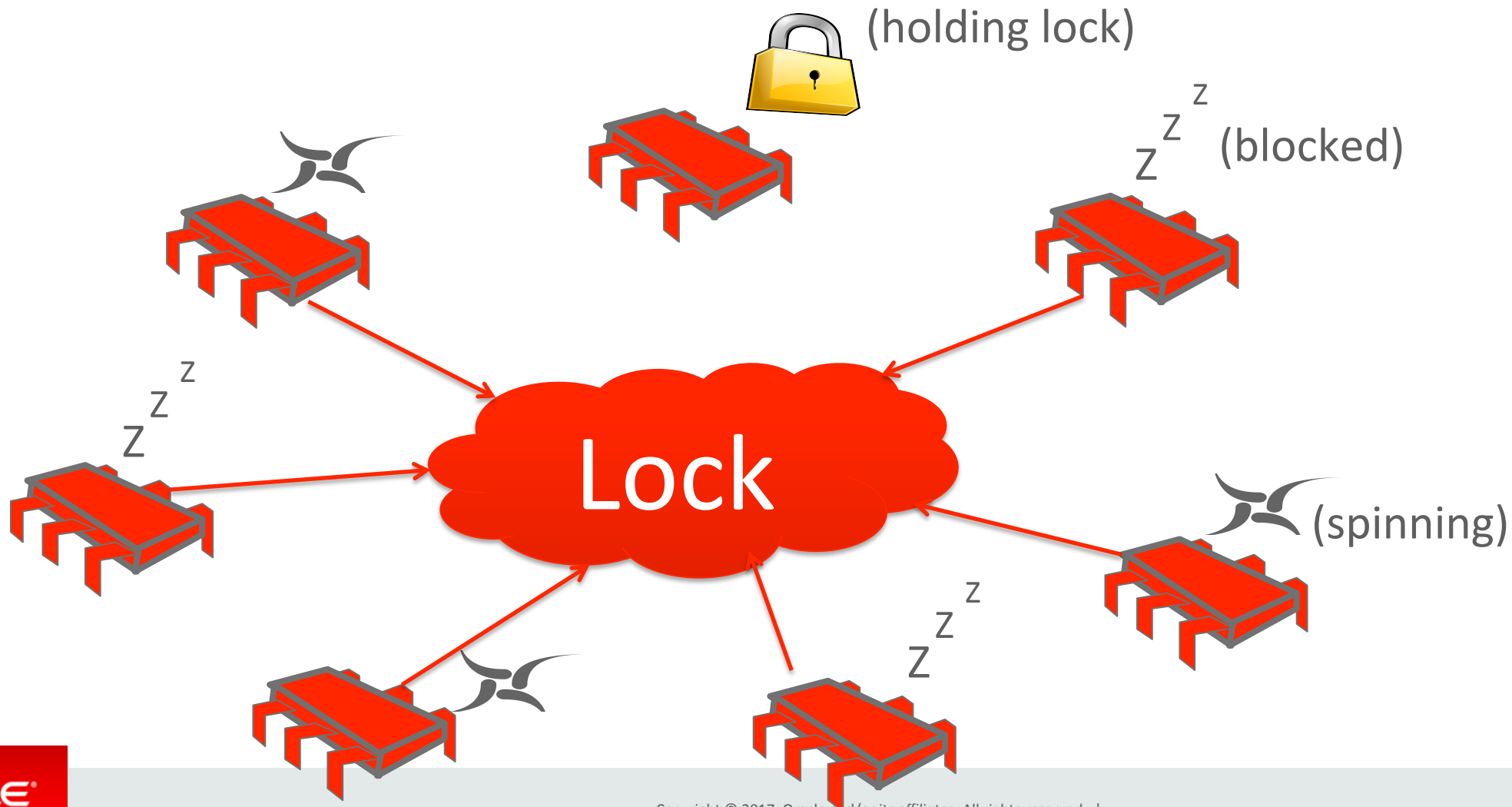


Growing #threads circulating through a saturated lock causes the overall application performance to fade

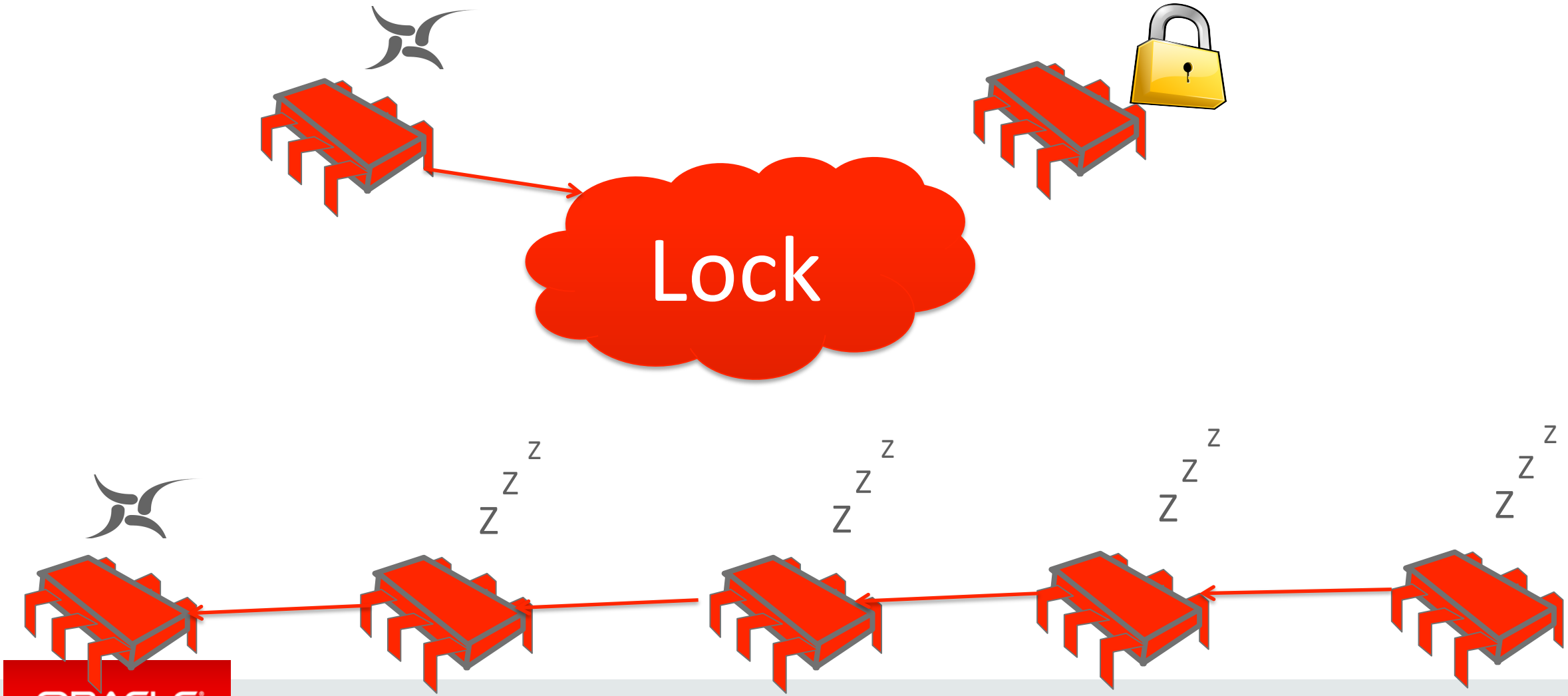
Why does it happen?

- Competition over shared resources
  - computing cores, pipeline availability
  - last-level caches, DRAM channel and interconnect bandwidth
  - thermal budget
  - etc.

Typical (spin-then-park) lock



Introducing GCR



What is GCR?

- The goal: keep the lock saturated by as few threads as possible

- Lock-agnostic wrapper
  - intercepts lock acquisitions calls
  - decides which threads would be allowed to proceed (aka remain active)
  - other threads form a queue and block (aka become passive)
  - periodically shuffle between active and passive
    - avoid starvation, achieve long-term fairness

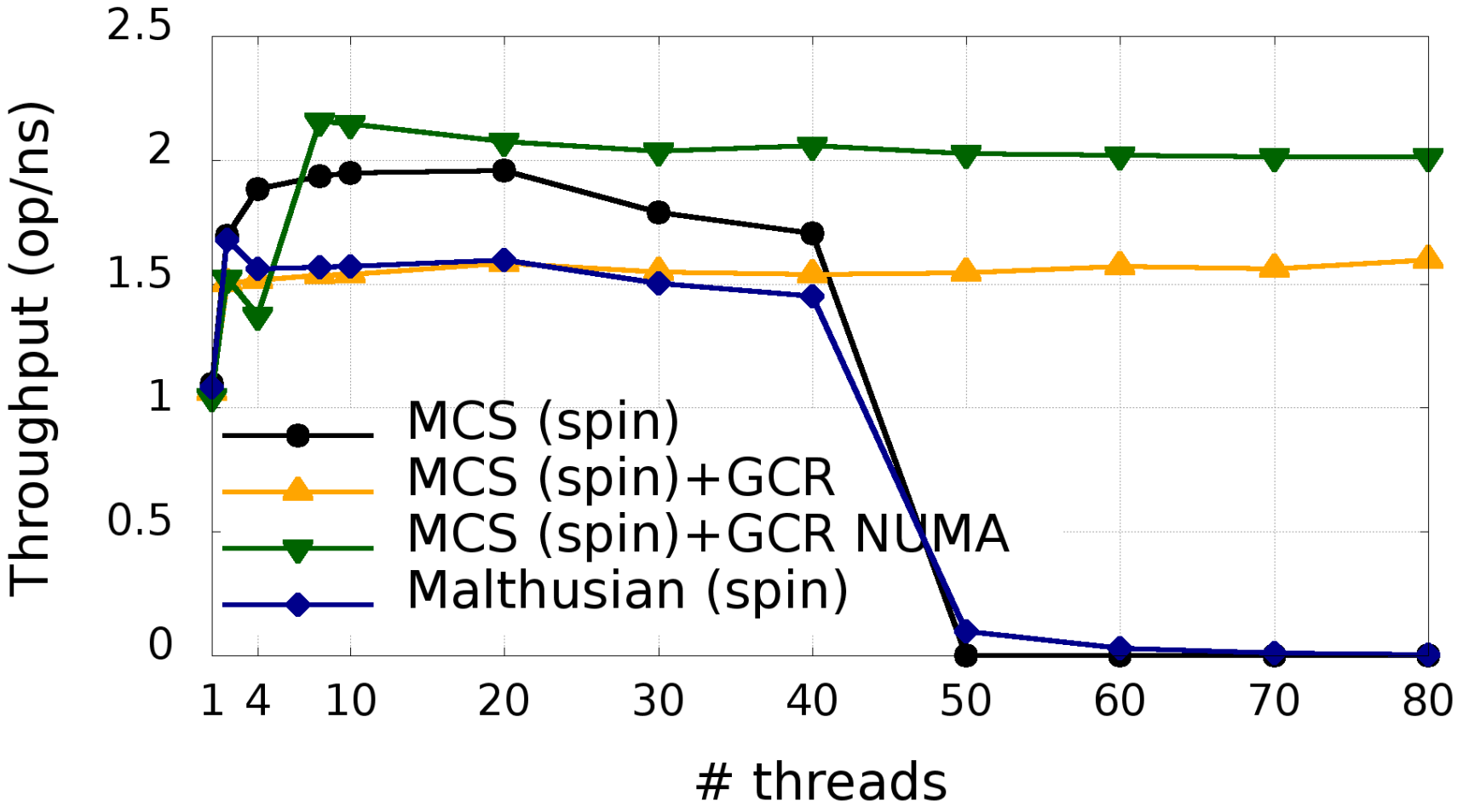
GCR-NUMA

- Maintains the set of active threads in a “NUMA-aware” way
  - composed of threads running on the same socket

- Can convert any lock into a NUMA-aware one

Preliminary results

AVL tree microbenchmark
2 Intel Xeon E5-2630 v4 procs, 40 logical CPUs in total



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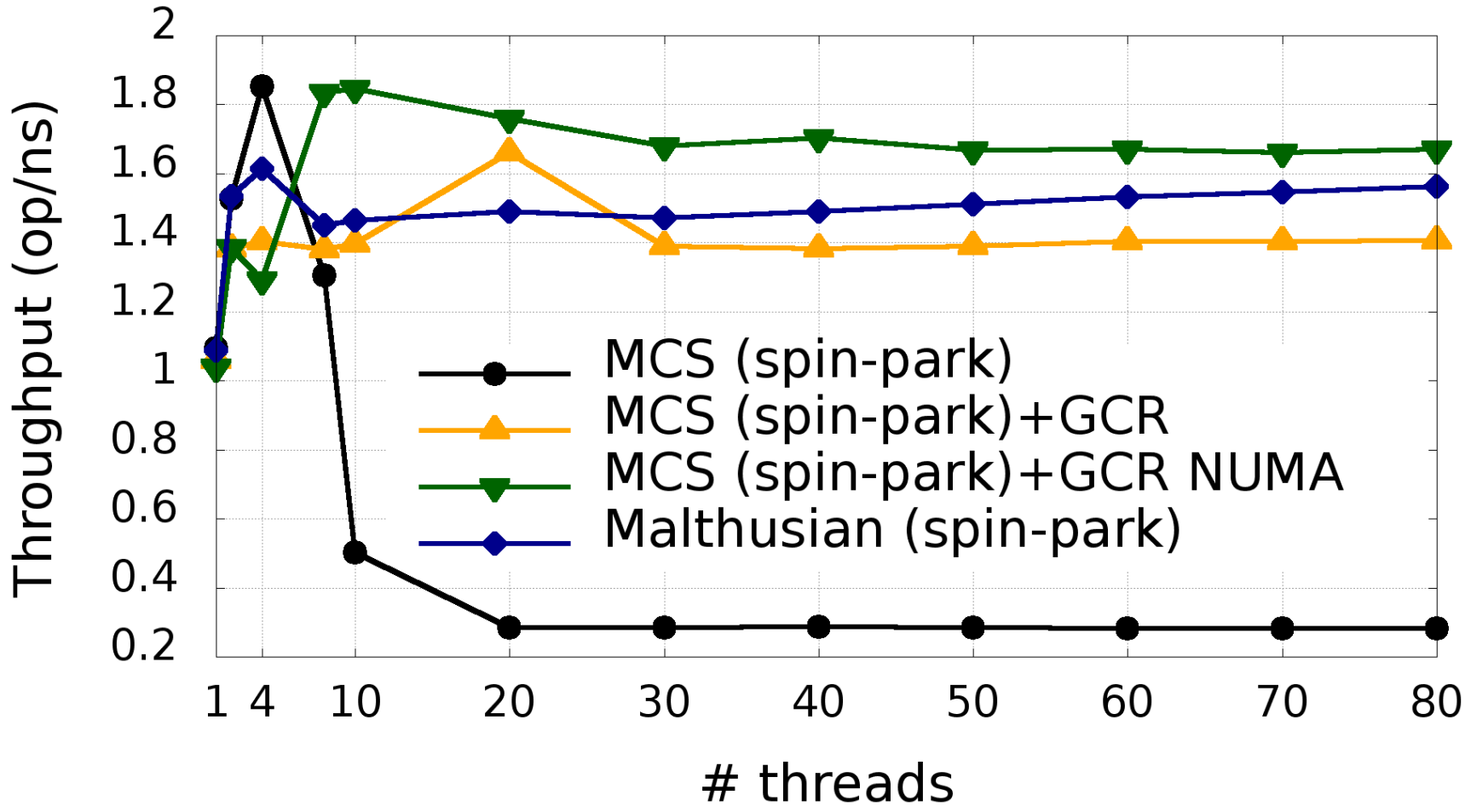

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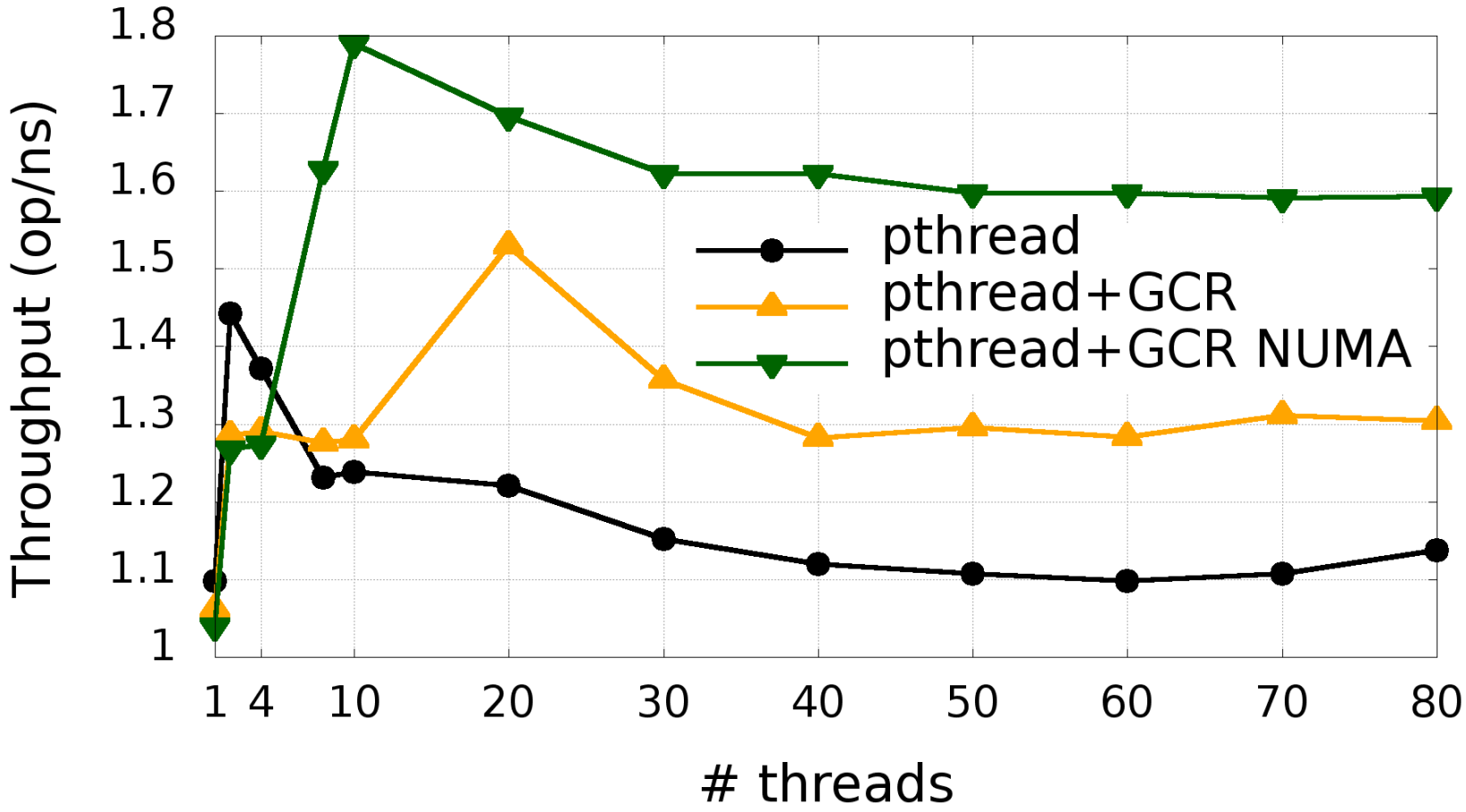

Wrap up

- GCR avoids the scalability collapse
  - keeps the lock saturated with a few threads
  - passivates all the rest
  - reduces contention and consumption of valuable resources

- Future work: adaptivity
  - disable GCR under no/light contention