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PennState

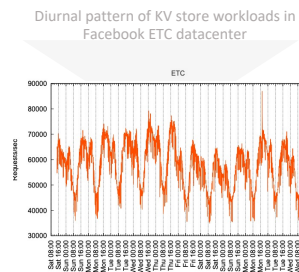
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Peafowl: In-application CPU Scheduling to Reduce Power Consumption of In-memory Key-Value Stores

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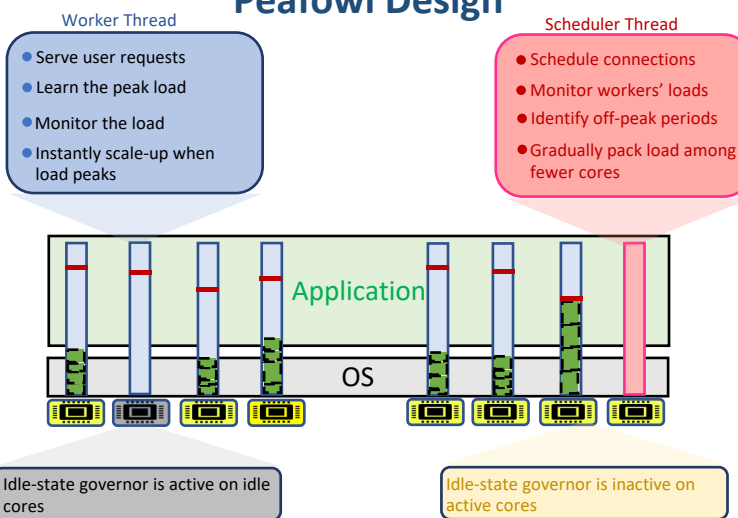
Problem and Motivation

- Tail latency of key-value (KV) stores impacts the overall performance of high-fanout applications
- KV store workloads have a diurnal pattern
- Service providers provide for **peak load** to ensure low tail latency
- Problem:** High energy consumption of ever-growing in-memory KV stores (i.e., cache nodes) in data centers



Goal: Save **power** during off-peak periods while ensuring **microsecond scale tail latency**

Peafowl Design

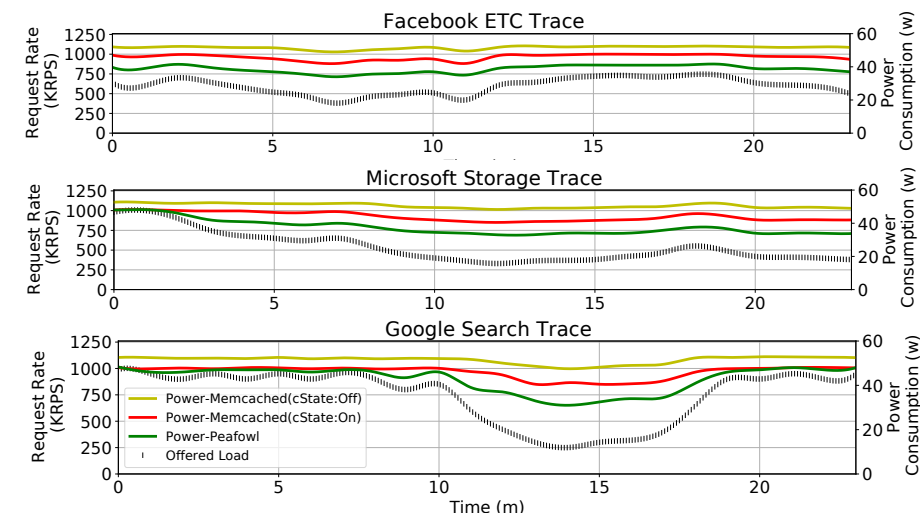


Idle-state governor is active on idle cores

Idle-state governor is inactive on active cores

Idea: Perform **scheduling** in the KV store to unbalance the load during off-peak periods

Peafowl in Action

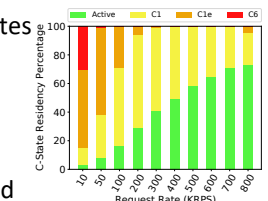


Peafowl saves **36%** more power while keeping tail latency at microsecond scale

Existing Solutions

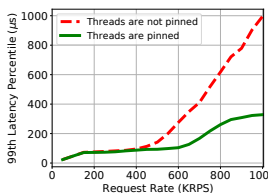
Idle-state governor: Force CPU into deep idle states

Problem: Short interarrival fragments idle periods



Feedback-based controllers: Monitor the load and adjust the number of allocated cores

Problem: Controllers rely on OS for scheduling → too slow

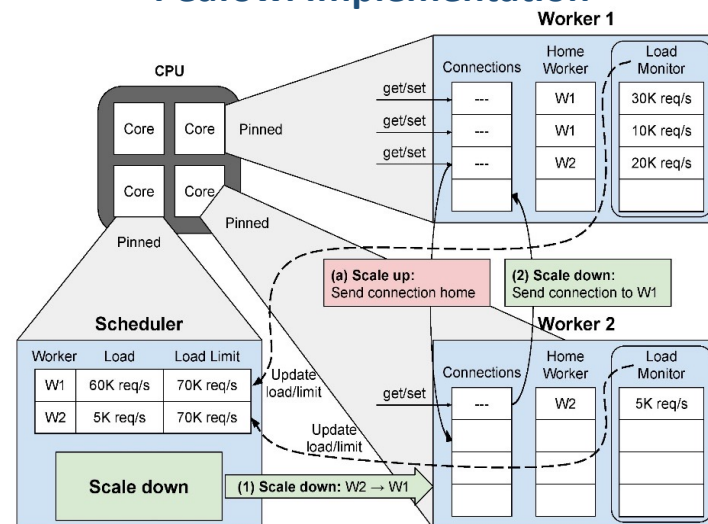


DVFS and request delaying: Exploit the latency gap to slow down the request processing

Problem: Due to the high arrival rate and short service time of KV store workloads, these approaches are not able to notably save power

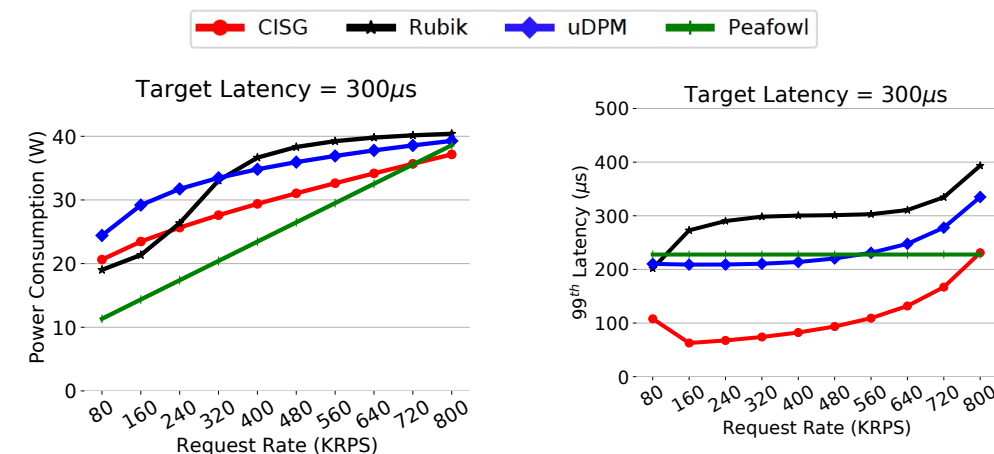
The high arrival rate, short service time, and tight latency requirements make existing solutions less effective

Peafowl Implementation



Open sourced at <https://github.com/showanasyabi/peafowl-kvs>

Peafowl Compared to Existing Approaches



Peafowl outperforms Rubik, μ DPM, and a Clairvoyant idle-state governor with up to **40%**, **54%**, and **45%** more power savings respectively