



Mobile Multicores

Use Them or
Waste Them

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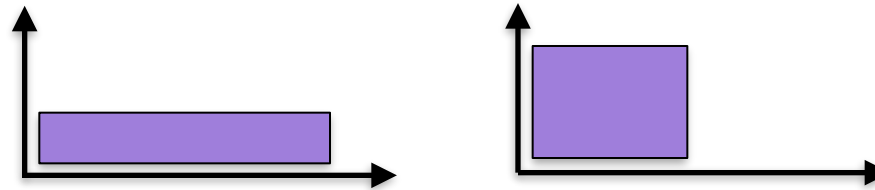


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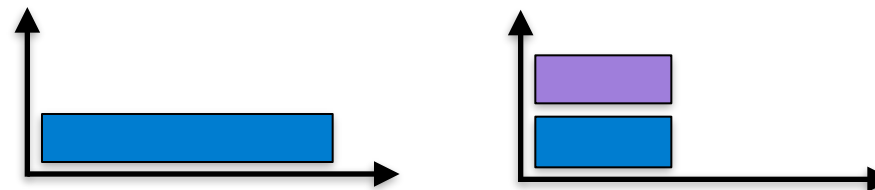


Introduction

- power control knobs:
 - DVFS



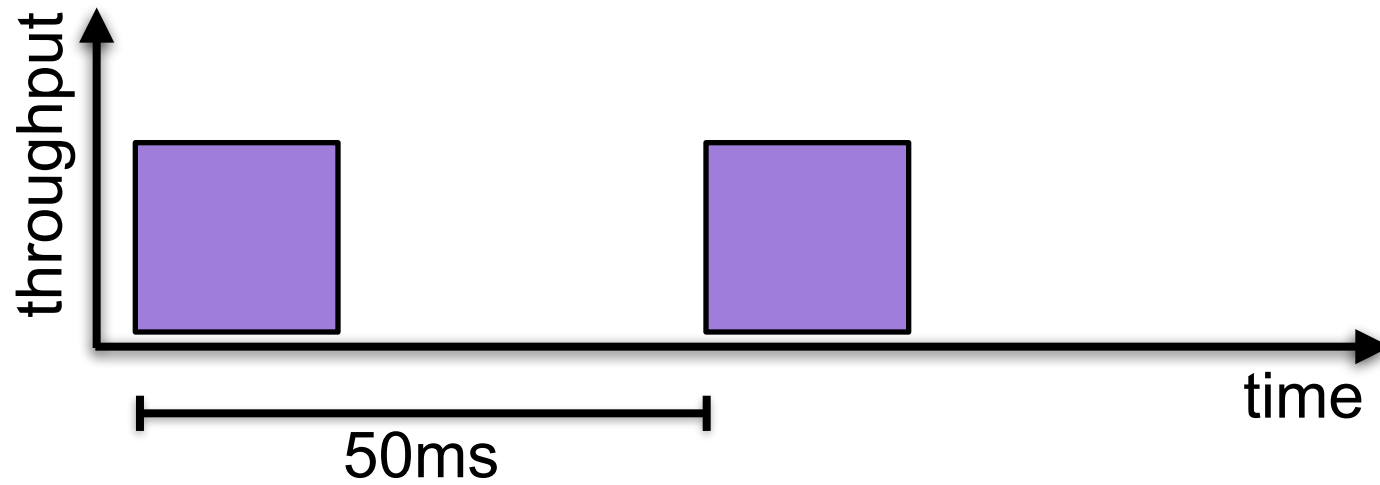
- #online cores



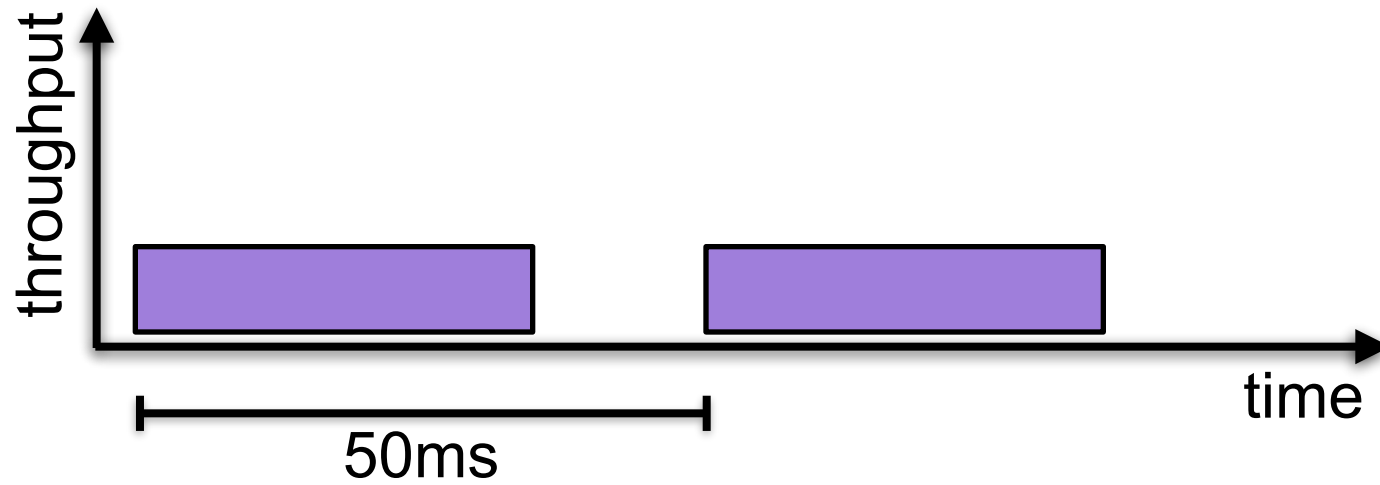
Problem

- trade-off between the two mechanisms?
- optimal **operating point**
 - frequency and #online cores
- **idle** energy management
 - under-utilised CPU
 - reduce energy
 - performance unaffected (ideally...)

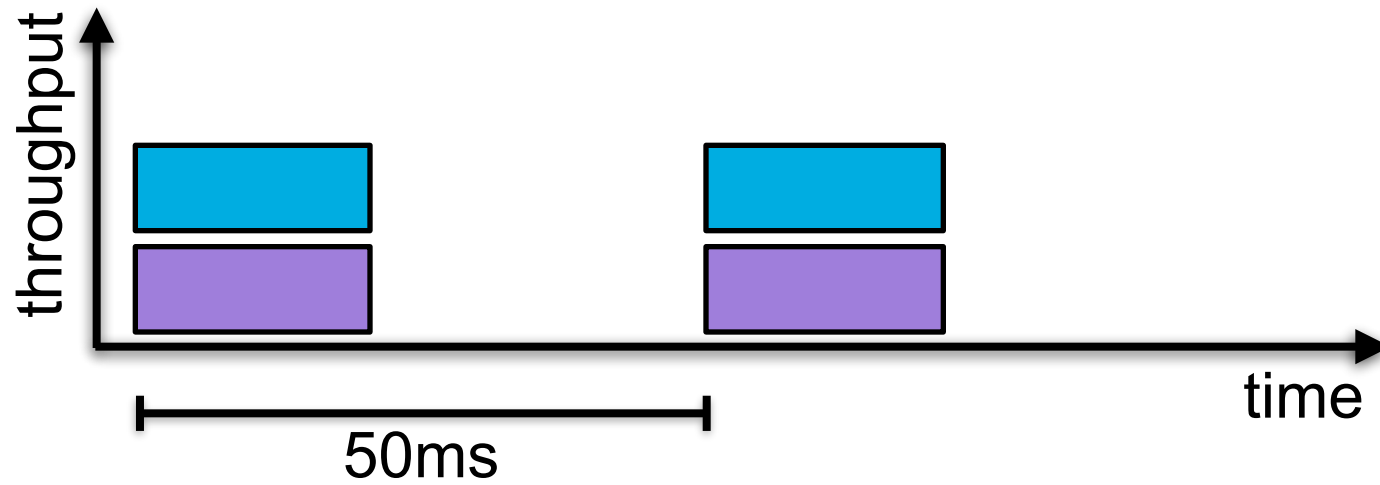
loadcpu



loadcpu



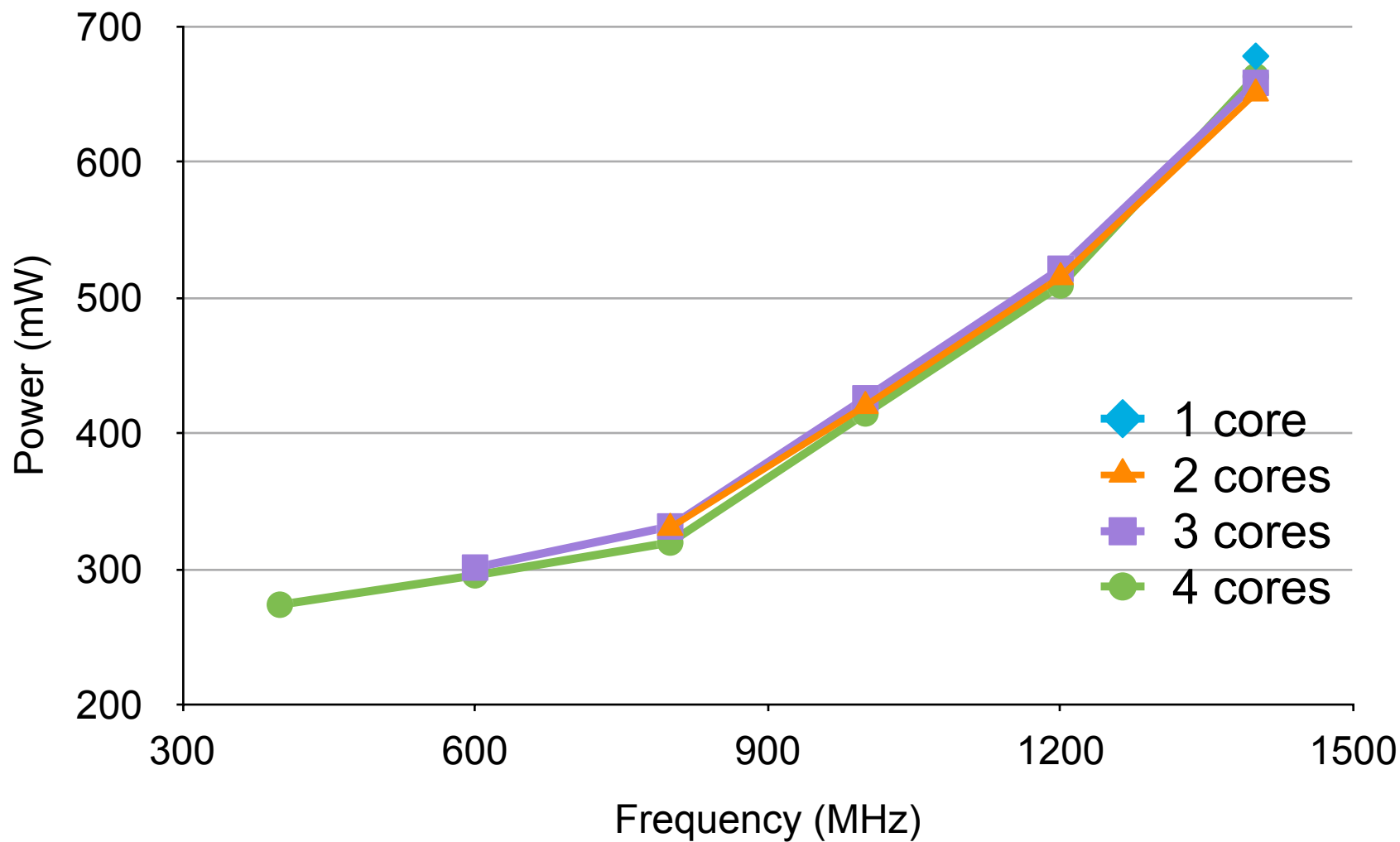
loadcpu



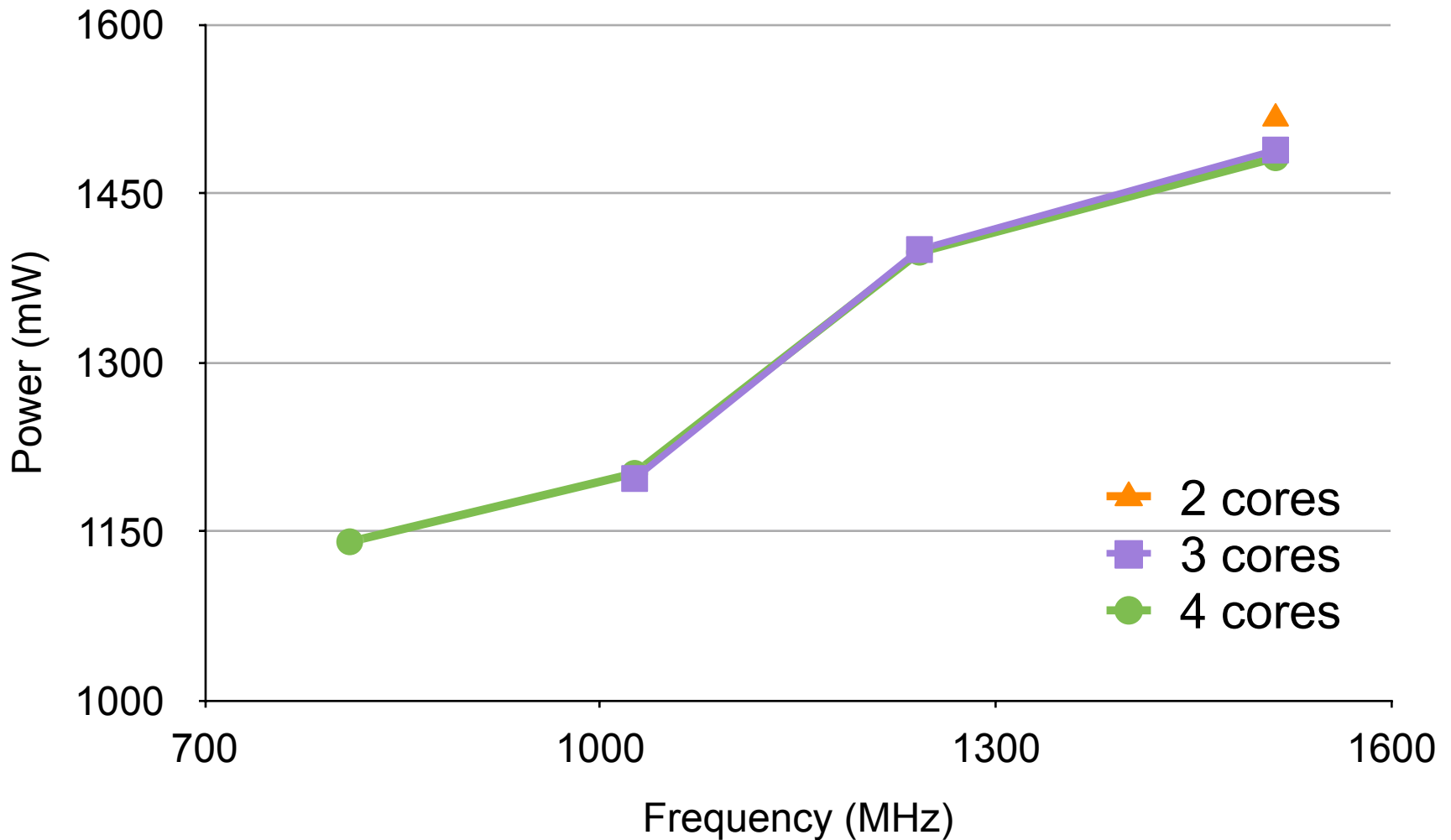
Devices



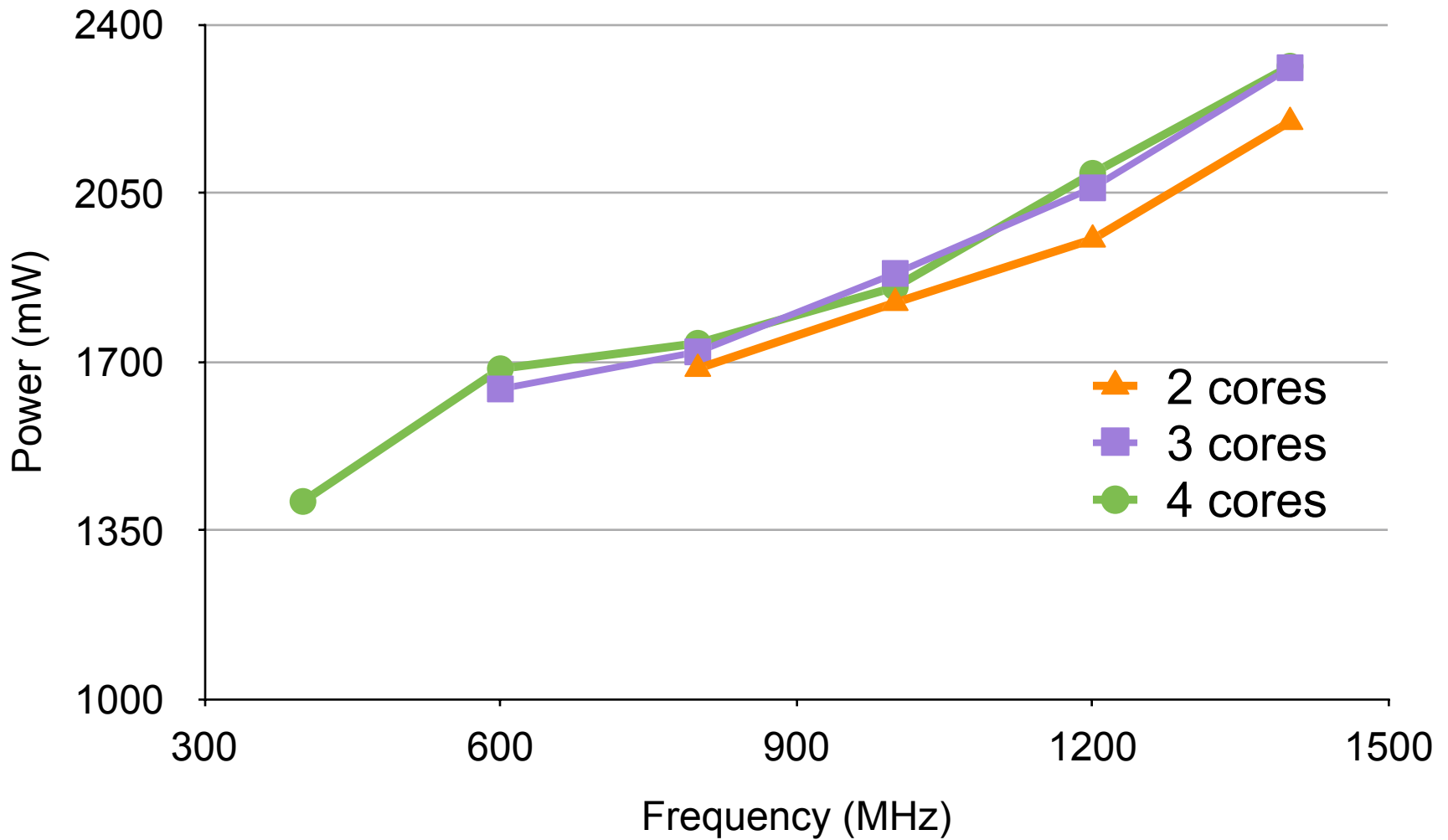
loadcpu S3 25%



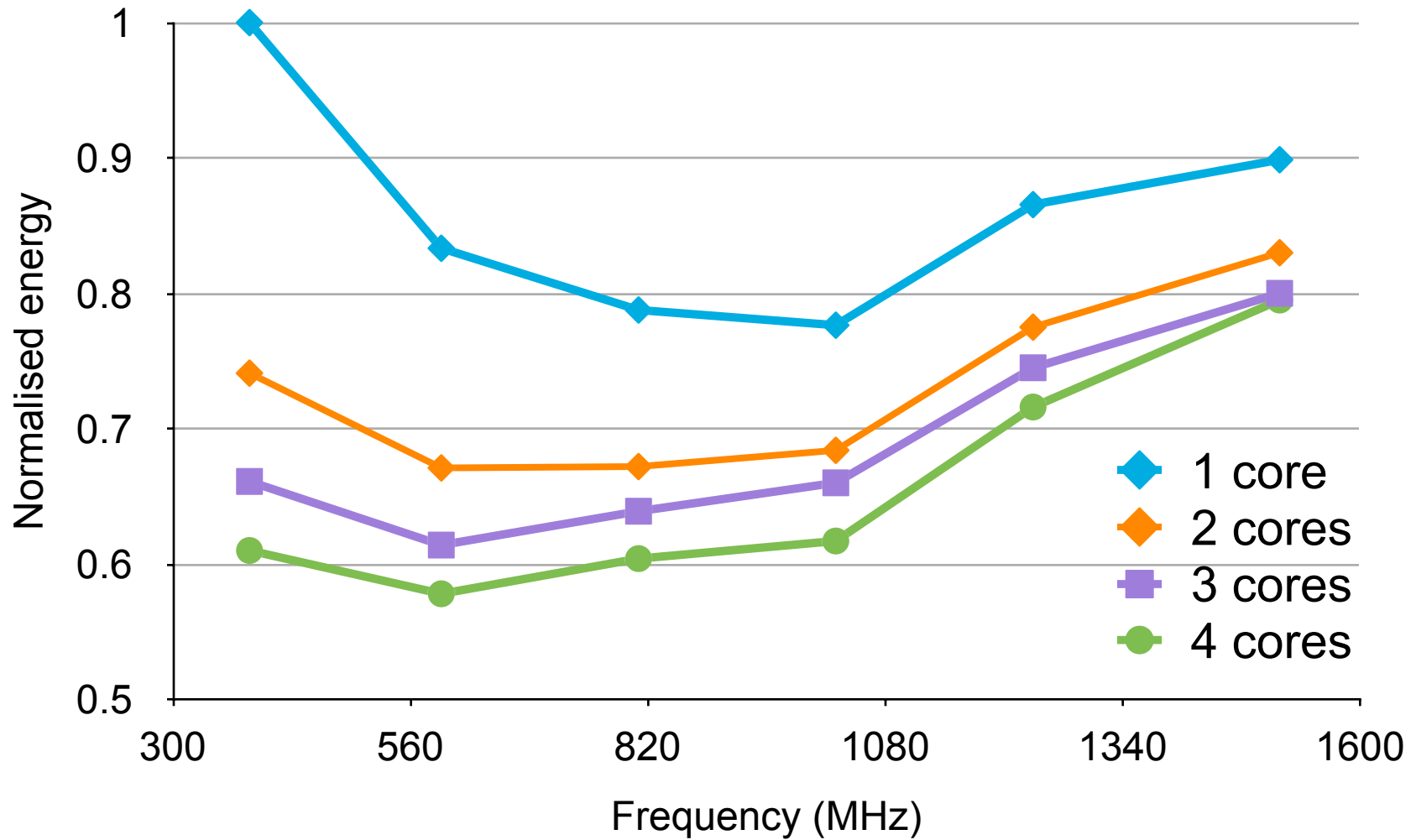
loadcpu MDP 50%



video S3



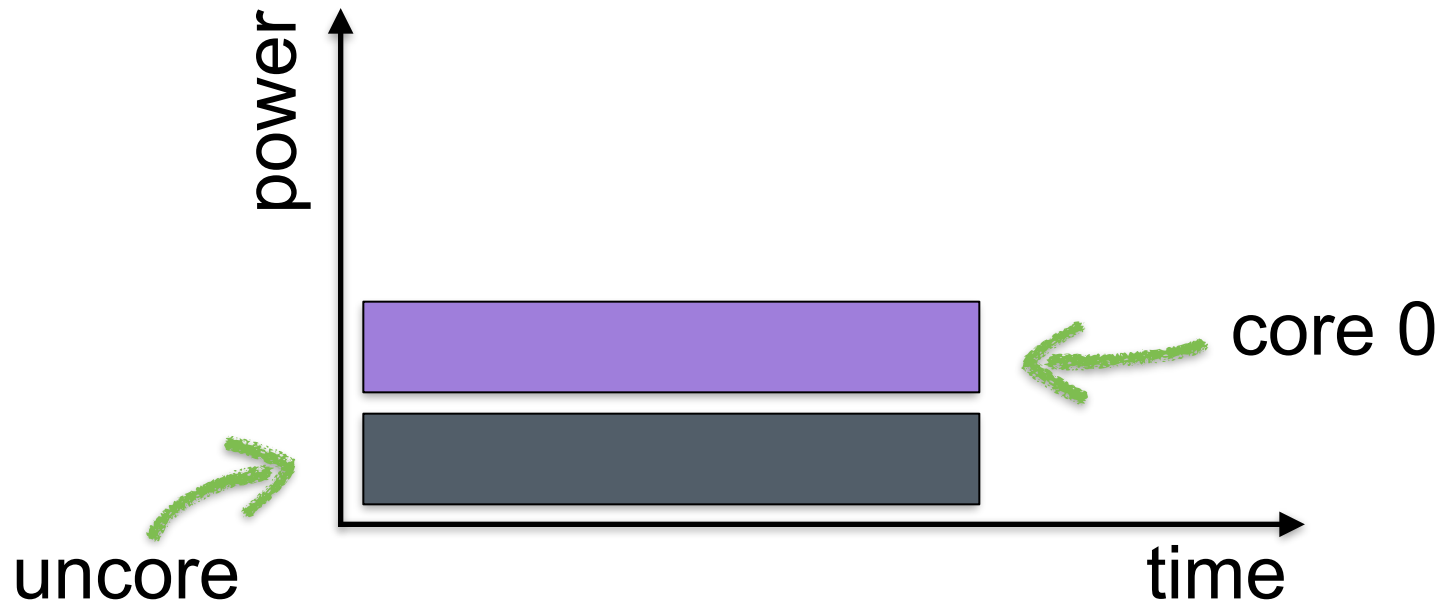
spin MDP



- Periodic
 - P independent of n at fixed f
 - decrease $f \Rightarrow$ lower P
- Compute-bound
 - P is a complex function of f
 - increase $n \Rightarrow$ lower P

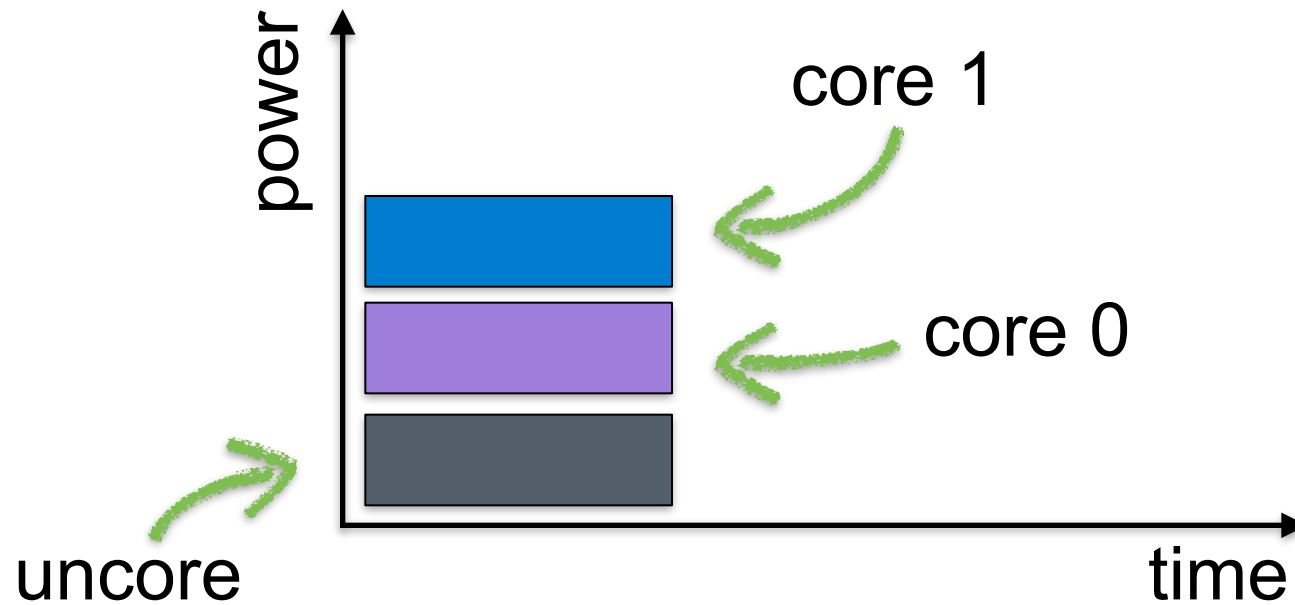
Analysis

Compute-bound:



Analysis

Compute-bound:



Compute-bound:

$$P = P_{\text{uncore}} + nP_{\text{core}}$$


$$E = P_{\text{uncore}}t + nP_{\text{core}}t$$

Assume scalability: $t \propto \frac{1}{n}$

$$E \propto \frac{P_{\text{uncore}}}{n} + P_{\text{core}}$$

Periodic:

$$P = P_{\text{uncore}} + n(P_{\text{active}} + P_{\text{idle}})$$



= P_{core}

T = period of workload

t = execution time

Assume scalability

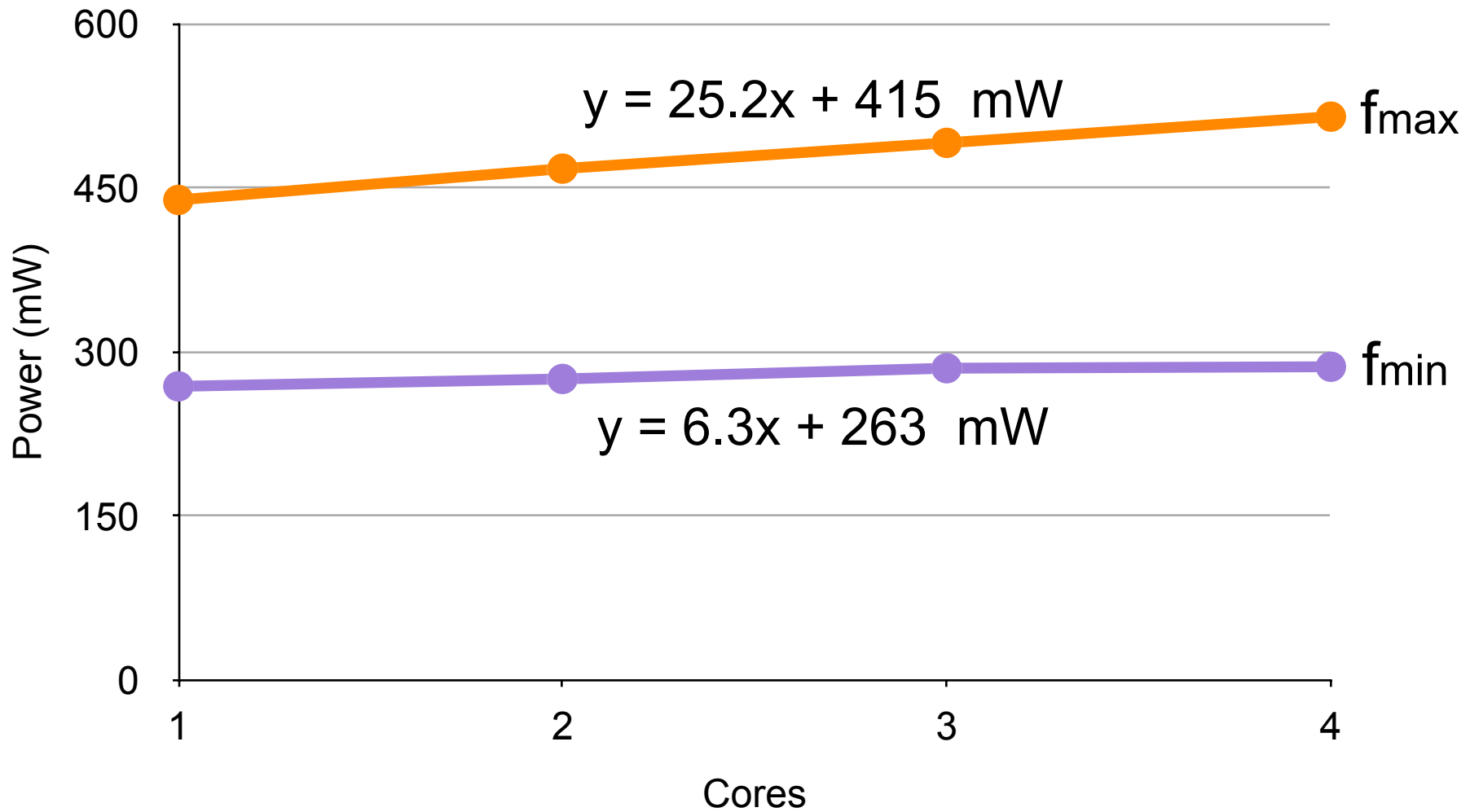
$$E = (P_{\text{uncore}} + nP_{\text{idle}})T + k$$

If

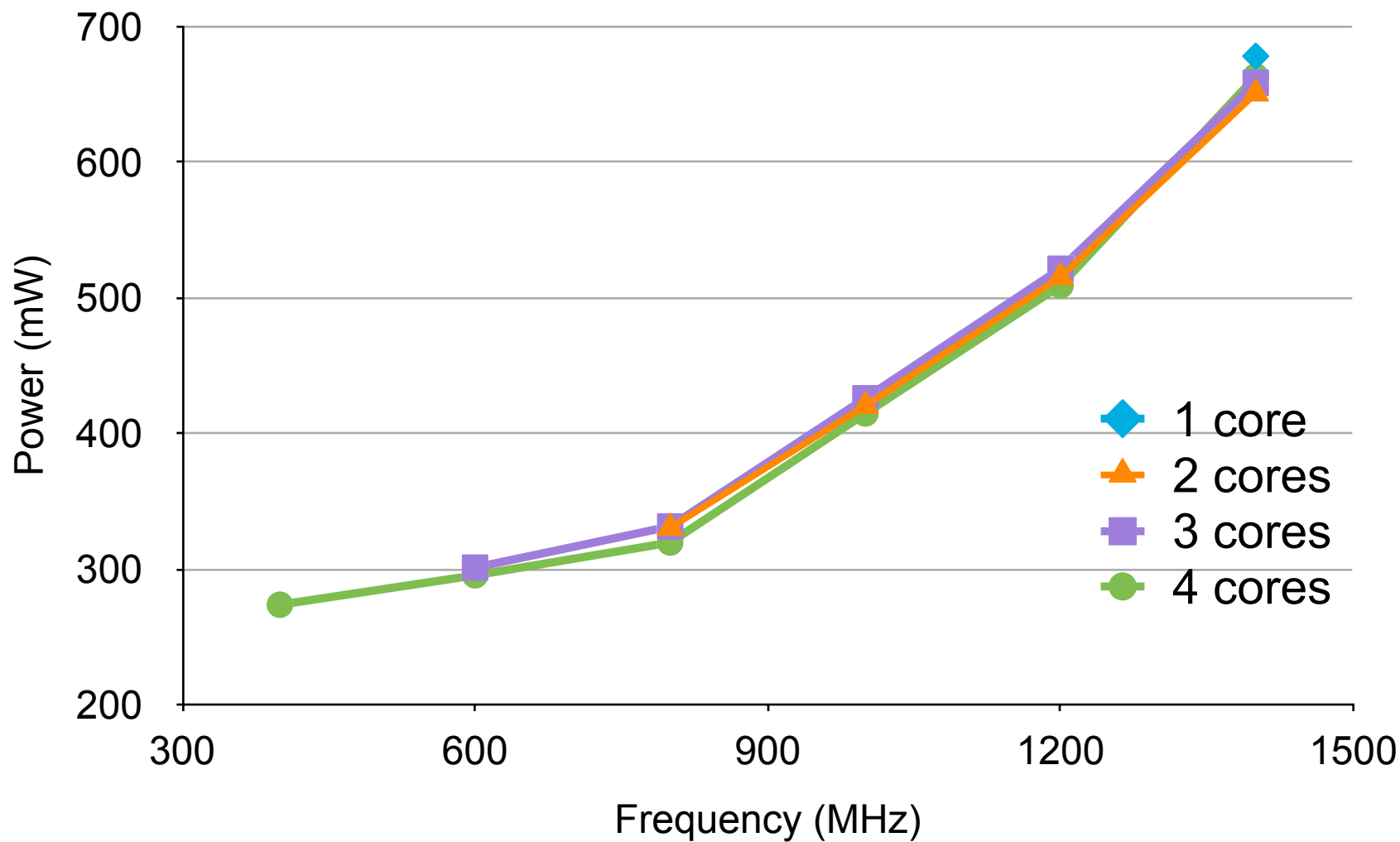
$$P_{\text{idle}} \ll P_{\text{uncore}}$$

then P is independent of n .

S3 idle power



loadcpu S3 25%

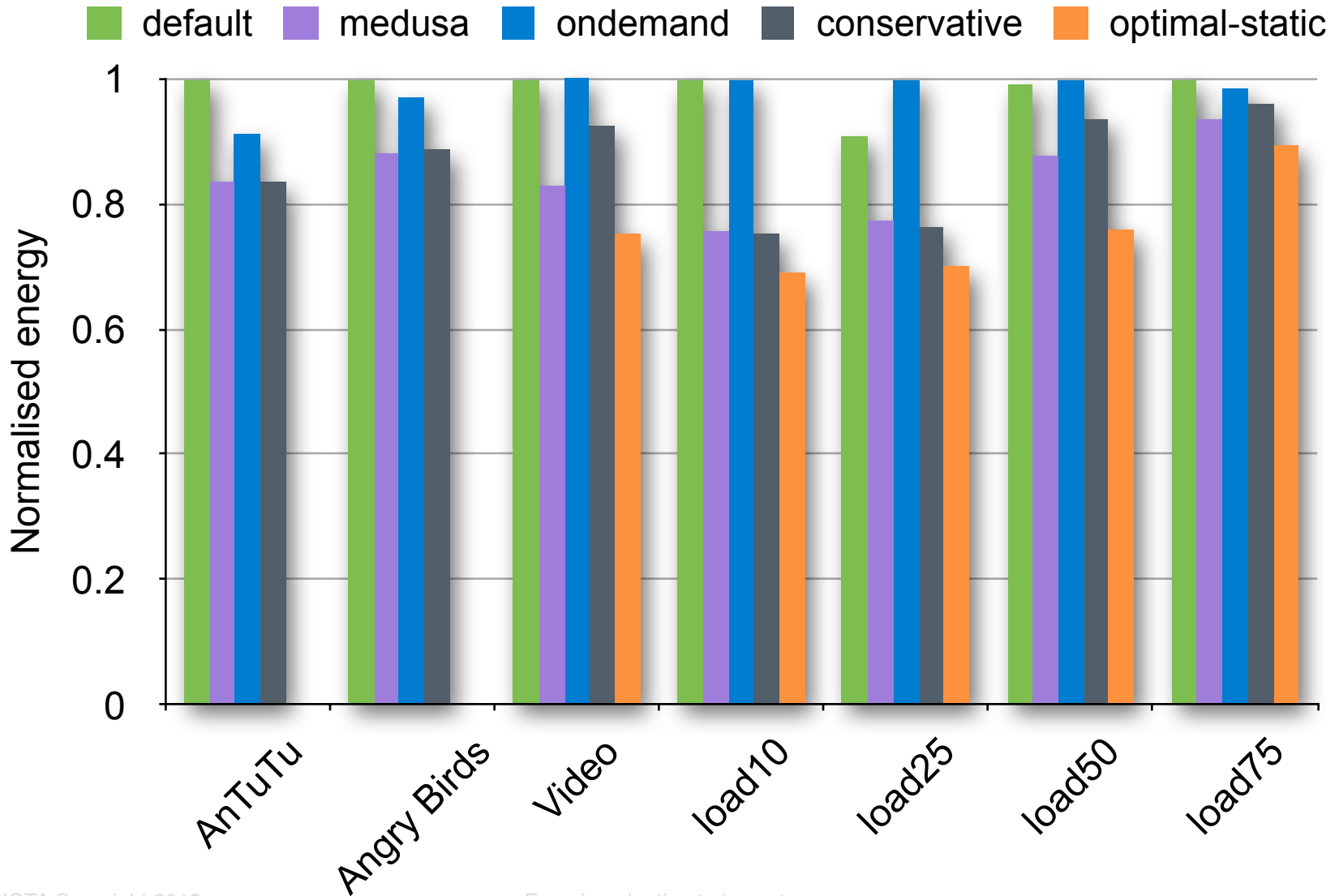


Conclusions

- Online cores to:
 - **unlock** lower frequencies
 - race to idle
- Policy design:
 - scale out before scaling up
 - offline cores conservatively
 - reduce frequency aggressively

- medusa: an offline-aware governor
- like ondemand: keep utilisation <100%
- try to achieve
 - minimum frequency
 - maximum #cores
- constrained by #threads

medusa



- onlining cores **reduces** energy consumption in most cases
 - access to lower frequencies
 - race to idle
- due to high uncore and low per-core static power
- medusa: up to 20% energy reduction



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