

# Energy Efficient Methods for Multi-Core Programming

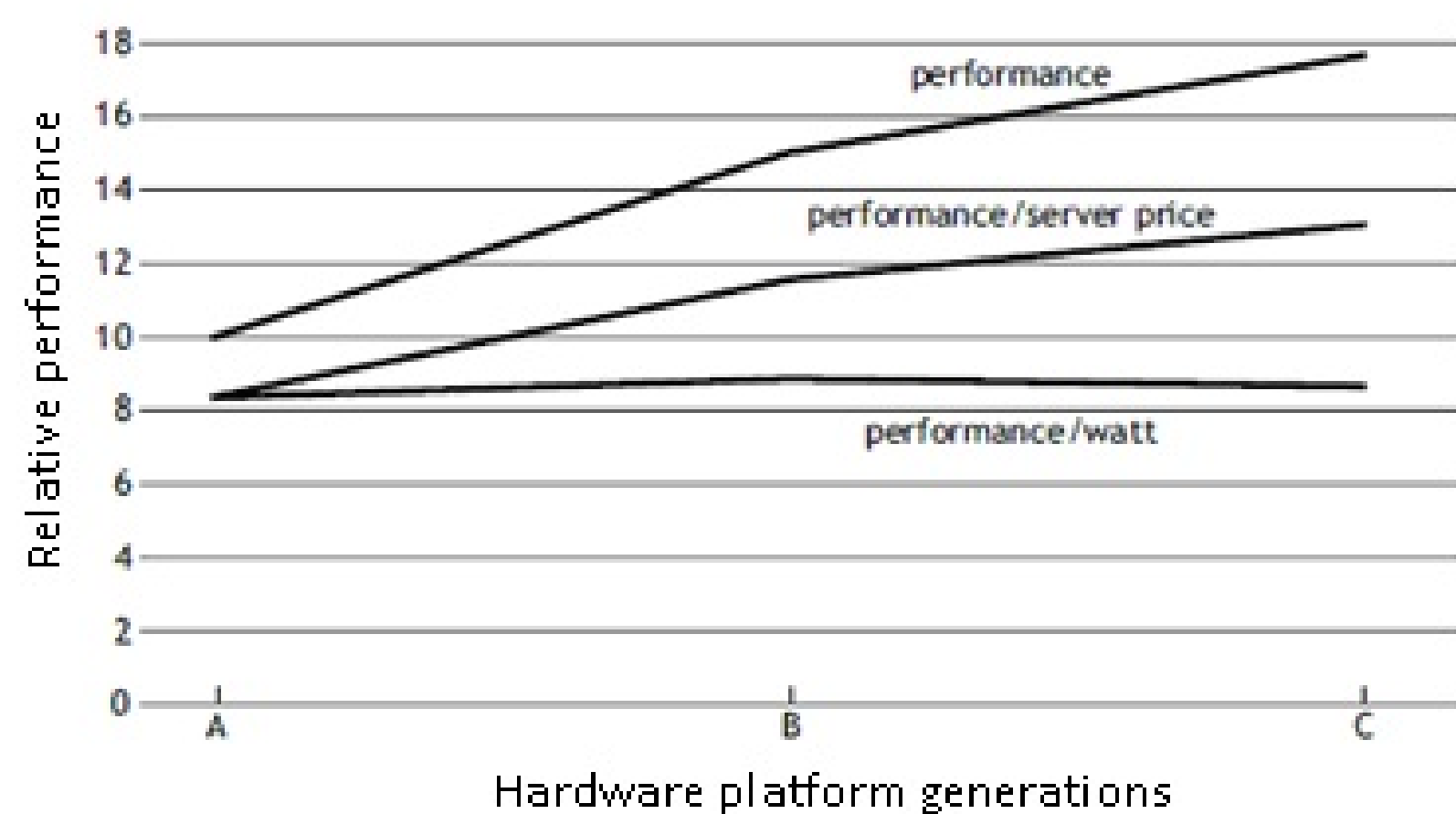
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## Background



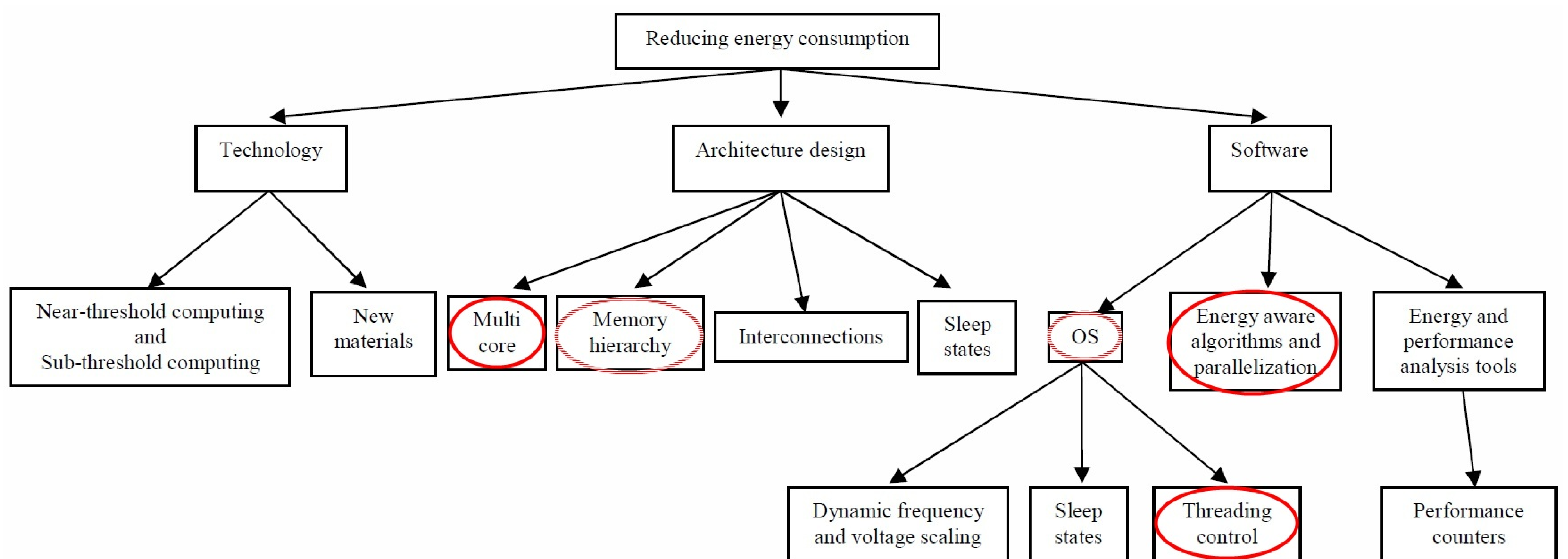
Google study results

## Definition

- Green IT = "a multifaceted global effort to reduce energy consumption and to promote sustainable development in the IT world" [Patrick Kurp]

## Green IT in computer science

- the power requirements of current computer systems are more than a sustainable development issue
- constraints: heat dissipation and energy costs



The technology branch

- envelops research in electronics (near-threshold computing) and science of materials (bismuth telluride)
- near-threshold computing involves some trade-offs: performance loss and performance variation

The architecture design branch

- homogeneous and heterogeneous multi-core processors
- on-chip cache memory hierarchies
- highly adaptive processor designs
- "multi-core aware" TLBs

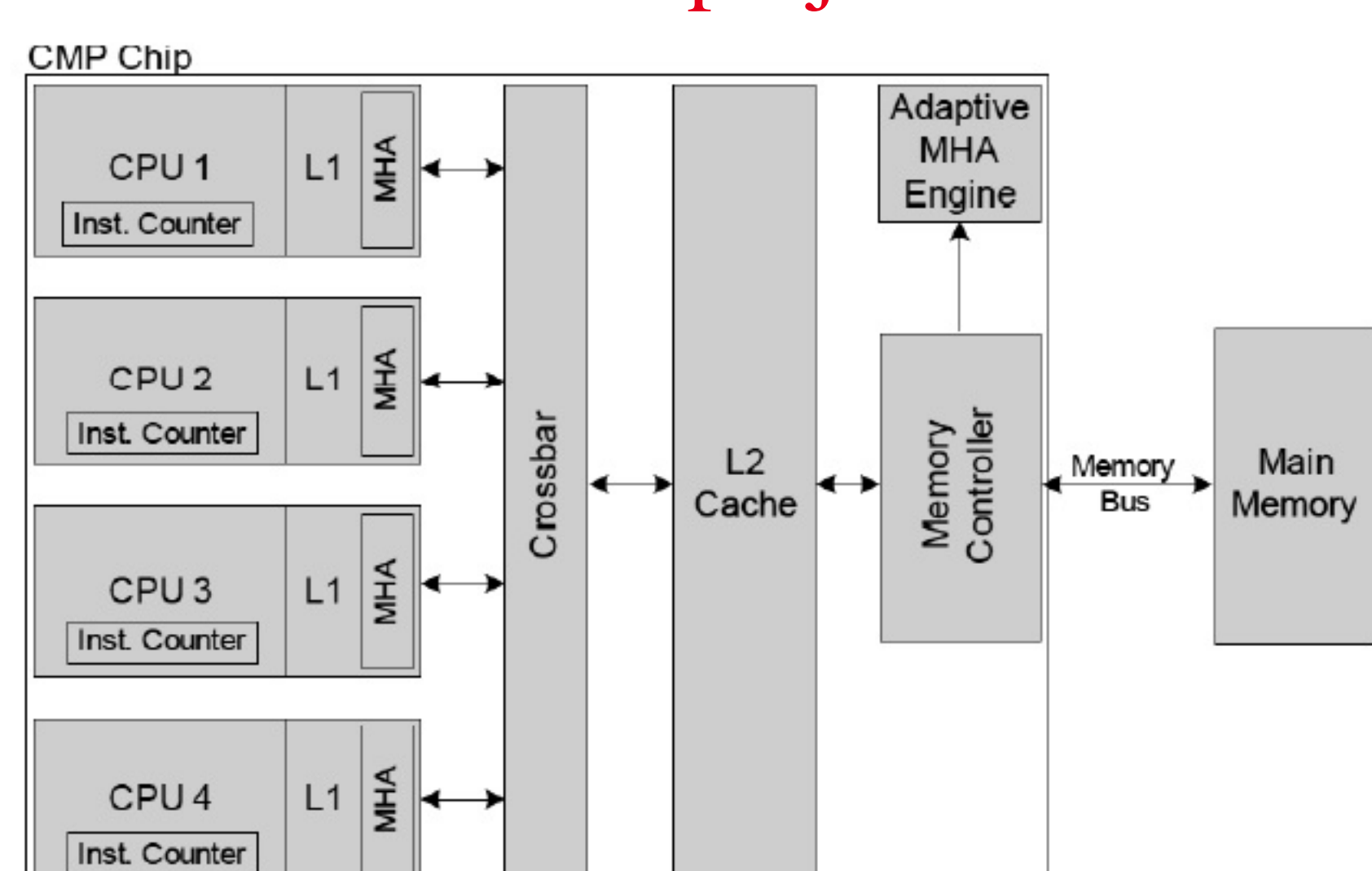
The software branch

- software parallelization
- power management tools
- performance counters (for performance analysis)
- energy profiling



energyAware profiler developed by Energy Micro

## Other multi-core projects at NTNU



Magnus Jahre's Adaptive Miss Handling Architecture  
<http://www.idi.ntnu.no/~jahre/>

- Marius Grannæs: **Reducing Memory Latency by Improving Resource Utilization** (PhD thesis)  
[http://www.idi.ntnu.no/research/doctor\\_theses/grannas.pdf](http://www.idi.ntnu.no/research/doctor_theses/grannas.pdf)

## Energy Efficient Methods for Multi-core Programming research project

- we will contribute to green computing research by exploring new programming approaches and use system level simulations of both architecture and software to validate the proposed techniques

## Research plans

In a preliminary form, our research stages include the following:

- improve the simulation framework (integrate the cycle-accurate simulator M5 with McPAT power and area estimation tool) (already achieved)
- study the energy consumption of the applications in the PARSEC parallel benchmark suit (focus on differences between few complex and many simpler cores as well as degree of parallelization)
- the primary goal of the project is the research on alternative parallelization that can be used to achieve better performance/watt on multi-cores
- investigate the benefits of heterogeneous multi-cores in the context outlined above