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Performance and Energy Optimal DVFS, Task Migration and Active Cooling for Multi-core Processors

Multi-core processors have become the de facto standard of computing systems in all market segments: smartphones, laptops, desktops, and servers. A fundamental problem is being able to control the operation of the individual cores so as to maximize some suitably chosen measure of quality of service. Often, the primary goal in the design of any computing system is to maximize its performance under various constraints, and the real price is the total energy expended by the system. For this reason, performance-per-watt (PPW) is the most suitable metric. PPW is equivalent to the number of instructions executed per Joule of energy. However, most of the previous works in this area are mainly for single-core processors, based on simplified power and thermal models therefore resulting in sub-optimal solutions.

Researchers at Arizona State University have developed a new framework for maximizing throughput and energy efficiency of multi-core processors. The solution incorporates dynamic voltage and frequency scaling (DVFS), task migration, and active cooling as the means to control the cores. The framework includes accurate power and thermal models, temperature constraints, the relationship between frequency, voltage, and temperature, and accounts for the dependence of leakage power and circuit delay on temperature.

Potential Applications

- Desktop Computers
- Laptop Computers
- Mobile Devices

Benefits and Advantages

- Advanced Thermal Models – Accounts for more variables and factors than previous models to create optimal solutions.
- Higher Throughput and Efficiency – 20% improvement in throughput and 220% increase in energy efficiency.
- Real World Applications – 37% improvement over current existing energy-efficient techniques available when applied to an Intel Sandy Bridge processor.

For more information about the inventor(s) and their research, please see Dr. Sarma Vrudhula 's directory webpage