In order to prove the viability of per core frequency scaling for multicore CPUs, we developed a power simulator that uses real parallel workloads to simulate the power consumption of CPUs with both non-uniform and uniform frequencies.

### System Design

- **System design diagram**
- **Scheduling Algorithms (First Come First Serve)**
  - Algorithm 1: Finds the first core that can meet the deadline
  - Algorithm 2: Finds the core that completes the task at the lowest frequency
  - Algorithm 3: Finds the core that completes the task at the lowest frequency. Then finds the best frequency for all tasks in a given window and adjusts them.
- **Power Simulator user interface**

### Estimated Power

- “...The power consumed by a core is (typically) proportional to the cube of its frequency” [1] and idle power is roughly 10% [2]
- **Notations**
  - $f$: frequency
  - $F$: Task finish time
  - $M$: Number tasks on nth core
  - $J$: Length of uniform frequency schedule
  - $S$: Task start time
  - $N$: Number of cores
  - $t$: run time

### Results

- Calculated maximum frequency change cost for the viability of CPUs with non-uniform frequencies.
  \[
  x = (P_2 - P_1 + 1.1(I_2 - I_1)) / (C_1 - C_2)
  \]
- Maximum frequency change costs for viable non-uniform frequencies.

### Conclusion

- Power simulation of normalized values shows that non-uniform frequencies may theoretically improve efficiency.
- Work is going to verify the theoretical results by measuring the real power consumption of multicore processors running a variety of workloads.

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### References