PRiME

Power-efficient, Reliable, Many-core Embedded systems

Power Budget-Aware Distributed Energy Minimization of Many-Core Systems

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<u>**Aim:**</u> Scalable energy minimization through decentralised concurrency and DVFS controls, guided by the power budget annotation

<u>**Key Messages:**</u>
This demonstrator illustrates the **PRiME** approach to distributed energy minimization of many-core systems. The approach uses power budget annotation in the application to constrain the max. power consumption. For a given power budget, the energy is reduced through multiple runtime agents:
- Each application thread is managed by a **power trading agent (PTA)**, which manages inter-thread power/performance trade-offs
- Each processor core is managed by a **DVFS controller agent (DTA),** which reduces the energy based on the power budget from the PTAs.

Economic trading is used between PTAs for power/performance trade-offs, and model predictive control algorithm is used to control concurrency (core allocations) and DVFS to reduce energy minimization within the given power budget, while achieving the best possible application performance.

<u>**Collaborative Working:**</u>
This demonstrator uses Newcastle's power model, which guides the concurrency control and power/energy estimation

<u>**How the demonstrator works:**</u>
The demonstrator runs on an Intel Xeon E5-2630, hosting 12 cores and a 32GB shared memory. Each core operates at a minimum frequency, f=1.2 GHz (at Vdd = 0.98V) and a max. f=2.6GHz (at Vdd = 1.35V), in total thirteen frequency levels. A PARSEC raytrace application is executed on a Linux 2.6.32 OS as a case study. The PTAs are implemented using modified *p_thread wrapper* implementation, while DTAs are implemented as *Linux power governors*.

Power trading between PTAs

Power Comparisons — Power, Watts

Energy Comparisons — Energy, Joules

Performance Comparisons — Frame rate, fps